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THE WAR *in the Valley*

DURING recent years we have come to feel that in the conquest of his world man has about mastered the obvious frontiers. His future concern would seem to lie in the more obscure realms of matter and energy as yet unknown to most of us. But so far as concerns the everyday world we are a bit complacent.

But now and then we are reminded that even in her most familiar aspects Nature may turn upon us ruthlessly. Whatever science may yet reveal, engineering still must stand vigilant to wield our present knowledge in defense of the ground already won against the elementary forces that surround us.

Today in the Ohio and Mississippi valleys all this once again has been brought home to us. With full regard for the accomplishments of pioneer engineering in America, this writer knows no more stirring chapter of engineering effort than the war against flood in the Mississippi basin.

It is appropriate that in that struggle leadership should be with the engineers of the army; for this truly is war. With Nature consistently the aggressor and man ever on the defensive, we must wage an endless war of successive campaigns and battles. In their menace to the well-being of a vast population the impersonal waters are as substantial as any invading host. To cope with them involves all the strategy and tactics, all the space-time relationships, all the resources of men, materials and equipment, all the morale and discipline that are the concerns of general staff faced by hostile invasion.

EVERY aspect of flood fighting maintains the parallel. Ten years ago, smarting under the latest destructive onslaught, the Corps of Engineers undertook to provide a defensive system that would turn the next attack. From Cairo to the Gulf, the traditional exposed frontier, it planned and labored on a permanent chain of defenses. Now once again the rivers mass their strength for a surprise attack. Recruiting their forces rapidly over a wide area they have overrun the open valley of the Ohio, overwhelming local defenses and leaving a trail of death and destruction.

As this is written, the triumphant invader is hammering at the newly fortified Mississippi front. Here, despite the planning and building of a decade, must be invoked also the tactics of mobile defense. Here must be assembled every available fighter to strengthen critical points as they may develop; here we must organize to evacuate the non-combatant population and to meet the unforeseeable contingencies.

IN ALL this the Corps of Engineers carries on with the full confidence of the people. It is too soon to know how adequate may be its barely completed permanent works but no one today doubts the soldierly readiness and technical resourcefulness with which it undertakes its grueling task of defending the Valley. And today's news from the front indicates that in this endless war the present campaign may well mark another victory.

In both its long-term and emergency aspects all this is the stuff of which drama is wrought. Part of it was unfolded in the series of articles that appeared in this journal since 1927. They described the ten-year program of permanent works. Now, in order to keep its readers down to date, two associate editors of *Engineering News-Record*, H. W. Richardson of New York and W. W. DeBerard of Chicago, have followed on the ground every step of the current struggle. Their dispatches, written by engineers and for engineers, have appeared in recent issues. Taken together, the long-term and the current stories present an epic of man's war against the destructive forces of his world.

Today, in the move toward more intelligent conservation of the land and its water resources, we are opening a new campaign in that war. It has been said that the soldier's function is to retrieve the blunders of the statesmen. It may well be that more statesmanship in the administration of our natural resources might have made unnecessary some part, at least, of the gallant and resourceful efforts we now demand of our engineer-soldiers. It may be also that even now a campaign of conservation will lessen the burden their successors must carry.

Willard Chevalier

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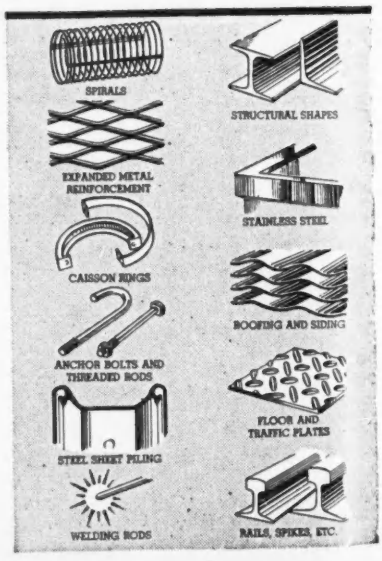

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Island Building— CALIFORNIA IS BUILDING an island in San Francisco Bay for the Golden Gate International Exposition. How eleven dredges are putting 3,500,000 cu. yd. a month into the fill will be told in an early issue.

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ENGINEERING NEWS-RECORD

February 18, 1937

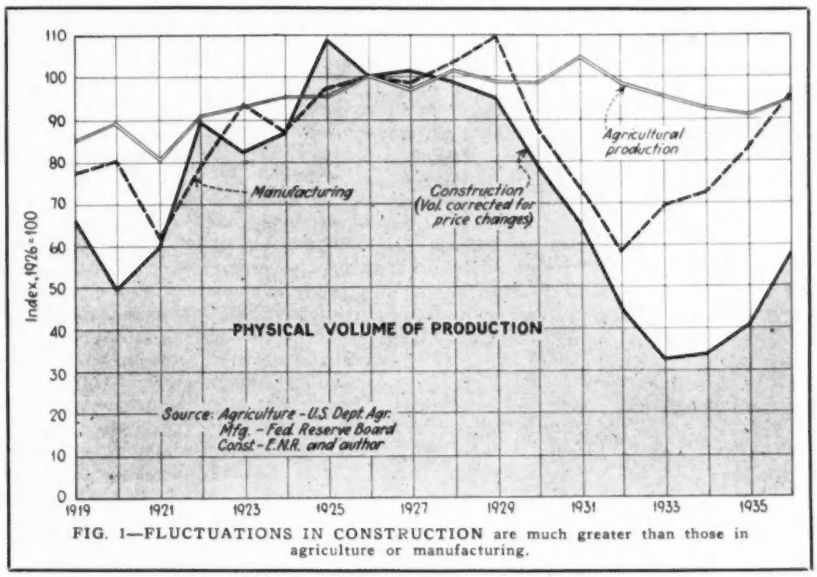


FIG. 1—FLUCTUATIONS IN CONSTRUCTION are much greater than those in agriculture or manufacturing.

Basic Factors In the Trend of Construction

Large variations in construction activity arise from economic and social changes as well as from governmental and financial influences

By Lowell J. Chawner

Chief, Const. Economics Section, U. S. Bureau Foreign and Domestic Commerce, Washington, D. C.

CONSTRUCTION activity holds fairly steady in terms of very long term averages over several decades but fluctuates greatly from year to year, more widely in fact than the volume of any other industry of comparable size. These fluctuations are sometimes assumed to be unintelligible, erratic, and inevitable. Important relationships, however, do exist between construction and other major economic, governmental, social and technical factors. The present understanding of these relationships is inadequate but has expanded considerably during the past few years. Its future enlargement promises highly useful results in lessening the violence of these fluctuations.

Wide year-to-year fluctuations in construction volume frequently obscure the true magnitude of the average long-time demand. Building permits per capita and the occupational statistics compiled by the Bureau of the Census, each of which covers a period of 60 years or more, lead to the conclusion that the relative position of construction in the economic life of the United States has been remarkably constant for many decades. From year to year, however, the actual demand for houses, factories, streets and roads, bridges, water supply systems and other works and structures, as is well known, fluctuates greatly.

As shown by the chart, Fig. 1, the wide changes for total construction (including alterations, repairs and maintenance) contrast sharply with the relatively moderate fluctuations in agricultural and manufacturing production. Similar swings have occurred in building every 16 to 22 years, at least since 1875 and probably over a much longer period. John R. Riggleman of the Bureau of Public Roads has investigated these fluctuations and has published some of his findings in the June, 1933, *Journal* of the American Statistical Association.

For several years, from 1923 through 1929, the total volume of construction of all types, public and private, and including alterations, repairs and maintenance was in excess of 10 billions of dollars annually. It reached a peak of about 13 billions in 1925 and declined to less than 4 billions in 1933. As a matter of fact, the latter year appears to have experienced the lowest physical volume of construction per capita since the 1870's.

Although the character of these fluctuations can be most properly understood by treating each branch of construction separately, there are certain factors, such as interest rates, that are common to nearly all types. Yields on high grade bonds (Fig. 2) were high or rose sharply in 1903-4, 1907-8, 1917-18, 1920-21 and 1931-33, which years were also periods of comparatively low building volume. Conversely, reduced or declining interest rates in 1905-6, 1909-10, 1922-28 and 1934-36 were accompanied by comparatively large activity or by substantial increases in volume.

Particular importance attaches to this factor today, in view of the fact that prevailing bond yields are lower than at any previous period in this country.

Unfortunately, this statement is not strictly applicable to interest rates on mortgage loans for houses and other forms of real property. In general, over long periods of time these rates, although usually higher, conform roughly to the trends in the yields on high-grade bonds. At the present time, however, mortgage interest rates appear to be about as high as pre-war levels and substantially higher than appears to be justified in terms of the large volume of funds seeking investment. Nevertheless, there are indications that keen competition among mortgage lenders has resulted recently in reducing interest rates.

Although there are some differences of opinion among competent observers, the prevailing judgment is to the effect that comparatively low interest rates, both bond yields and mortgage loan rates, are likely to prevail for several years.

Superimposed upon the wide swings in activity of several years duration are shorter year-to-year variations having widely different characteristics for different types of construction. The fluctuations in many of these types of work are closely related to associated economic, technical, governmental, and other factors. A thorough and completely satisfactory analysis of all of these factors in their relation to construction would be a very extensive undertaking and would require more satisfactory statistical materials than are now available. It is possible, however, to suggest some of the basic factors that have influenced certain fields of construction, during the past 20 years.

Residential building

Over long periods of time residential building averages from one-fourth to one-third of the total volume of construction in the United States, though it has varied greatly from this proportion in recent years. From 1920 to 1930 the average number of dwelling units built was 700,000 annually in urban and rural non-farm areas; and the dollar volume, including alterations, repairs and maintenance averaged between 3 and 4 billions. In 1933 the number of new units built declined to 60,000, considerably less than the requirements for normal replacement. No other branch of construction activity is on the average as large or fluctuates as violently as does residential building.

The physical needs for dwelling units are essentially local in character, but with suitable allowances for migration may quite properly be stated in terms of national totals. The economic demand for new units depends upon a large number of social and economic factors such as: (1) The number of families added by marriages in excess of dissolutions by death or divorce; (2) net immigration over emigration, (3) internal migration; (4) level of family income. Additions to the standing supply are likely to take place when vacancies are low and rents relatively high in comparison with construction costs, interest rates, taxes and other elements of the annual cost of ownership.

Fig. 5 shows an index based upon estimates of the number of new dwelling units built annually in urban and rural non-farm areas in the United States, over the period from 1915 to 1936. This index is based on Bureau of Labor Statistics compilations and other data.

The rent index of the National Industrial Conference Board based upon month-to-month changes in new rentals in 173 cities reached a peak in the summer of 1924, following the period of very active increase in physical needs and in actual economic demand for dwelling units from 1918 through 1923. This demand resulted from the large number of marriages during these years, the substantial volume of post-war immigration, and farm to city migration.

Marriages reached a peak in 1920 and immigration in 1923 just prior to the enforcement of the Quota Act of the following year. The urbanization movement was large throughout the whole post-war period up to 1930 but was a maximum in 1922. In periods of increasing demand such as that from 1918 through 1923 the volume of residential building appears to be particularly affected by interest rates and construction costs.

Since 1930 vacancy statistics (which are one of the most satisfactory measures of the residential market) have been compiled for an increasing number of cities. These data indicate that vacancies in many cities in 1932 were as high as 8 per cent of the total number of dwelling units. This rate has been steadily declining, particularly during 1935 and 1936, and in several cities has reached very low levels, in some cases less than 2 per cent of all habitable units which trend may soon result in a serious shortage of housing.

At the present time conditions are similar to those immediately after the war. Marriages in urban areas are larger in number than at any previous period and farm to city migration has resumed substantial proportions. Increasing costs of construction due to skilled labor shortages and advancing material prices may retard actual building. Any possible lowering of interest charges upon home mortgages would, however, stimulate this type of construction, particularly under present favorable conditions in the demand for housing.

Industrial construction

Industrial construction appears to be particularly responsive to basic economic factors. In Fig. 3 an index of this type of construction is compared with manufacturing production and the net earnings of manufacturing corporations. Although the industrial construction statistics upon which this index is based include some electric light and power plants in addition to manufacturing building, the latter represents 80 per cent or more of the total and dominates the fluctuations.

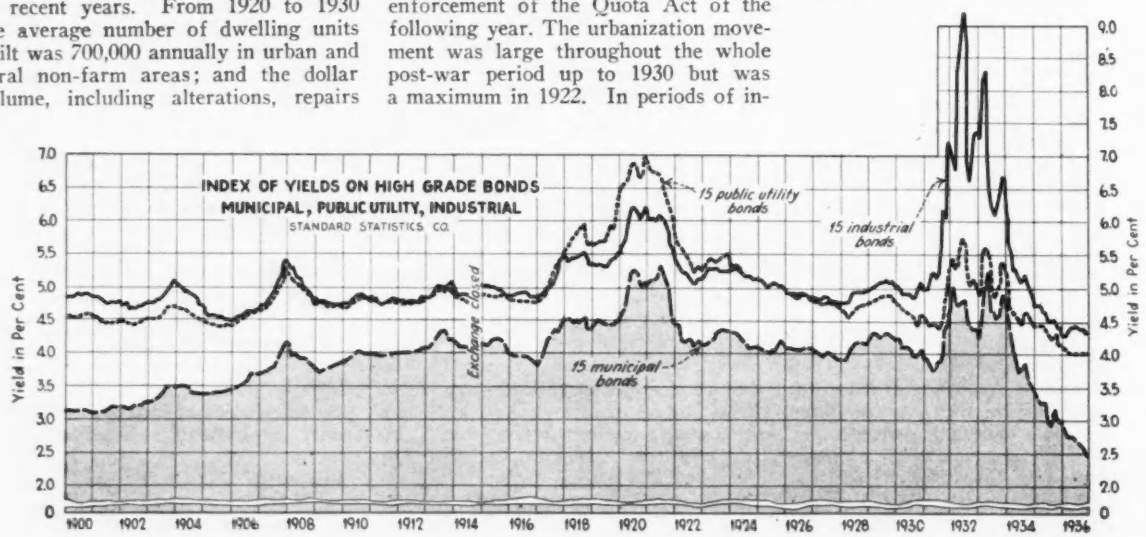


FIG. 2—HIGH INTEREST RATES discourage construction—1907–1908, 1920–1921, 1931–1934 were poor construction years.

It is not surprising that the volume of this type of work should be so closely related to earnings when it is realized that they measure the success of a business and frequently the justification for expansion. Industrial construction is stimulated not only by prospects but is also made financially possible by actual earnings and to a lesser extent by the effect of improved earnings upon the credit position of manufacturing companies. The notable exception in 1919 and 1920 to the otherwise reasonably close agreement between earnings and construction was due to the many changes in manufacturing processes following the World War and to the Revenue Act of 1918 and subsequent amendments, which contained sweeping depreciation provisions applicable to industrial plants in any way connected with production of commodities contributing to the prosecution of the war.

It might be thought that a number of economic considerations such as interest rates, prices, and costs of construction would also affect the volume of manufacturing construction. In the case of costs and interest rates this does not appear to be true for factories, although it is conspicuously true in certain periods for residential and other types of building. Many other factors, such as technical developments in various industries, legal changes, such as the removal of the 18th Amendment or the taxation of undistributed profits as well as disturbed labor conditions and fluctuations in wage rates of manufacturing labor, do influence the volume of factory building. This type of construction especially follows the short term changes in general business.

Commercial building

Economic information that might be helpful in understanding the volume of commercial building has not been developed quite as fully as similar information for industrial, residential, and other types of construction. This type of work is also dependent somewhat more upon local conditions than is industrial construction. In Fig. 4 there is charted, however, an index of the dollar value of commercial building contracts awarded in the United States, together with the vacancy percentages compiled by the National Association of Building Owners and Managers.

The vacancy statistics are based upon conditions existing in larger office buildings in a number of cities and the commercial building index refers to all types of commercial building. Nevertheless, the correspondence between the two is significant. It appears that new construction may be very substantial and well sustained as long as vacancies are from 8 per cent to 10 per cent; when they are much higher than 12 per cent new construction is likely to be sharply curtailed.

At present, vacancies are still more

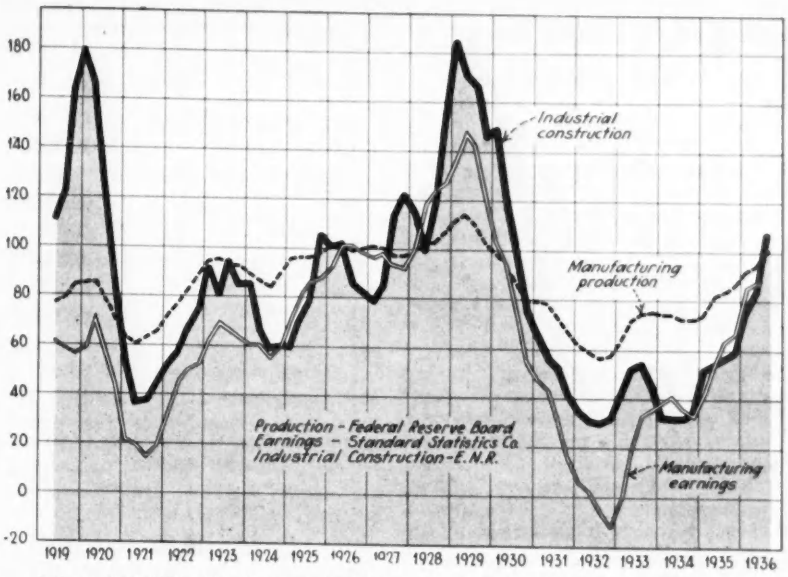


FIG. 3—INDUSTRIAL CONSTRUCTION is strongly influenced by industrial earnings. Index, 1926 = 100.

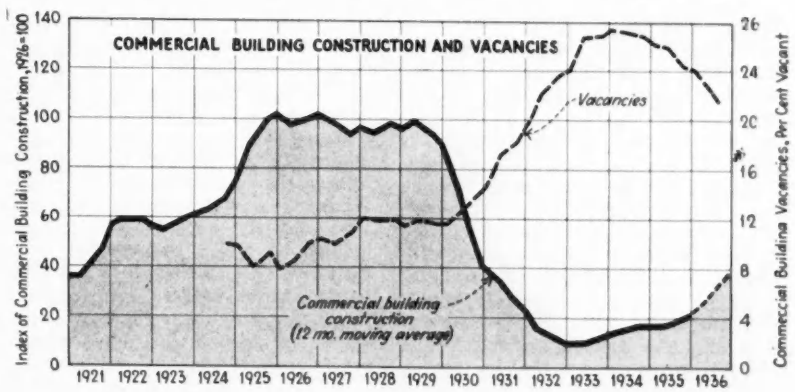


FIG. 4—COMMERCIAL BUILDING is closely related to vacancies. Vacancy of 8 to 12 per cent may result in substantial building activity

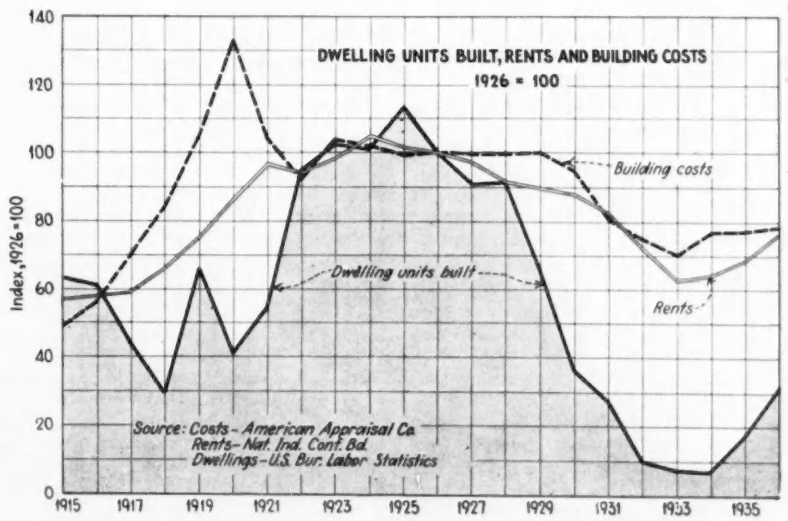


FIG. 5—RESIDENTIAL BUILDING is closely related to rent levels.

than 20 per cent. Before any large volume of new construction is likely to occur, present commercial building space must be more fully utilized, with consequent effects upon rents and improved income to owners of this type of property. Competition among property owners in obtaining tenants has resulted, however, during the past year, in a large volume of modernization of store fronts, the installation of improved heating, ventilating and other facilities, and similar alteration, which is likely to continue for some time to come.

When the demand is relatively large, interest rates, construction costs, and other factors that determine annual costs of ownership are of much greater importance in the case of commercial buildings than of industrial building. As a matter of fact, these annual charges represent a major part of the total costs of ownership and operation of offices, stores, warehouses and other commercial buildings.

Municipal construction

Factors influencing the volume of public construction are not wholly unlike those for private work. They do, however, exhibit many essential differences and are not in all cases susceptible of close economic analysis. The following, however, play an important part in the determination of the volume of public construction: (1) The recognized physical needs of a community; (2) the prevailing public policy with regard to governmental responsibility for supplying these community needs; (3) the fiscal condition of government agencies; (4) competing requirements of other government activities such as expenditures for relief and other current responsibilities.

The extent of the physical needs for all public works will always be subject to the prevailing standards of living which in the past has been gradually increasing. The translation of these needs into specific terms has been made by such agencies as the Federal Employment Stabilization Board, and more recently by the National Resources Committee and the Public Works Administration in conjunction with the state planning boards. In 1935 the Public Works Administration released a summary of the results of such an inquiry, which reports that the present volume of needed public construction is more than 12 billions. This is in addition to annual maintenance and is approximately five times the annual volume of public construction during the years 1927 through 1931 when such work was at highest levels. Fig. 6 shows in detail the volume of various classes included in the above totals of needed construction. Approximately 5 billions of this total is work of state agencies, and some 4 billions is that of municipalities. Needed federal construction is comparatively small, approximately one-tenth of that shown for municipalities.

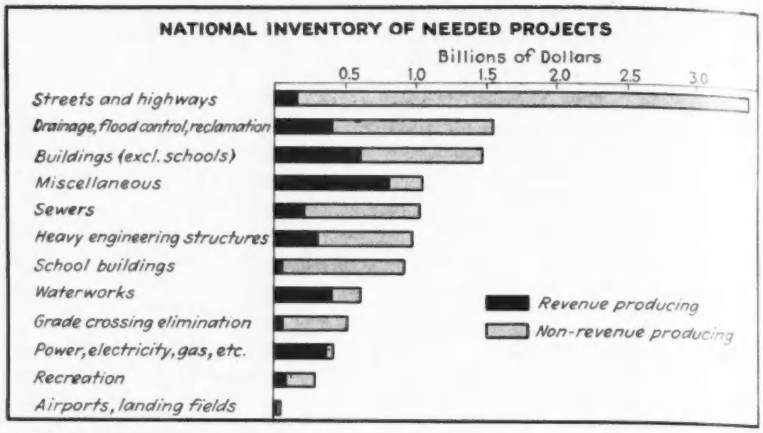
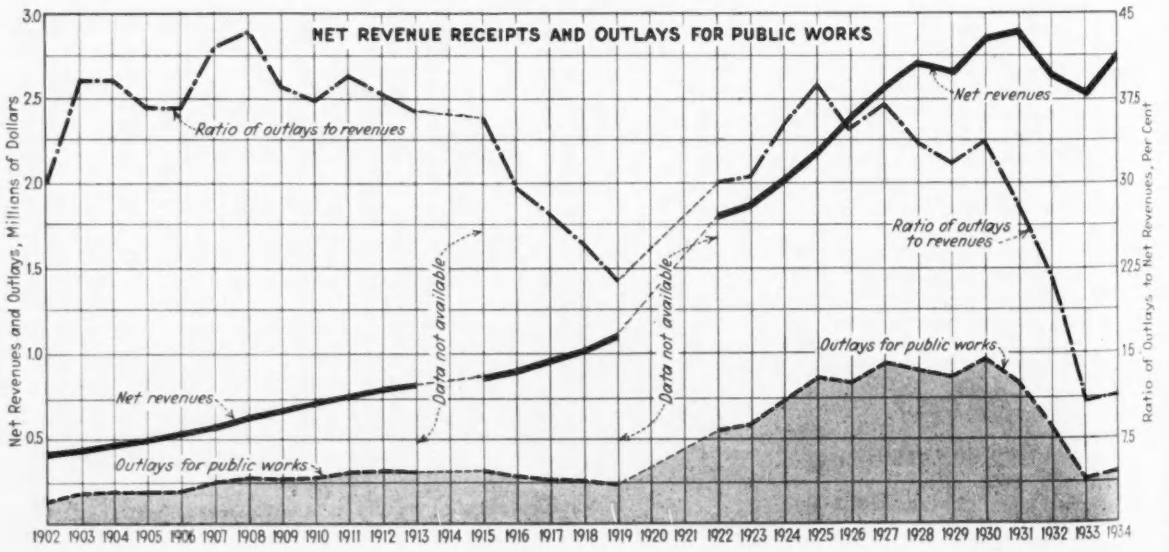


FIG. 6—LARGE UNFILLED public construction needs were found in a survey by PWA.

Space limitations confine the discussion of public construction primarily to municipal work, which in the past has amounted to one-half of the public construction and represents about one-third of the total needed construction. From available statistics it is not readily possible to separate municipal outlays for fixed works and structures from other types of durable goods outlays and land purchases. Construction work of various kinds undertaken by municipalities, such as streets and roads, buildings, water works and sewerage systems, however, does represent the major part, roughly three-fourths of the reported outlays.

In Fig. 7 these total outlays for a number of cities are compared with the net revenue receipts. The striking increase in the volume of total outlays of

FIG. 7—CITY CONSTRUCTION outlays compared with city revenues. Note the great drop in construction after 1930 while revenues remained high.


NET REVENUE RECEIPTS AND OUTLAYS FOR PUBLIC WORKS
Net Revenues and Outlays, Millions of Dollars
Ratio of Outlays to Net Revenues, Per Cent
3.0
2.5
2.0
1.5
1.0
0.5
45
37.5
30
22.5
15
7.5
Ratio of outlays to revenues
Net revenues
Data not available
Data not available
Net revenues
Ratio of outlays to revenues
Outlays for public works
Outlays for public works
1902 1903 1904 1905 1906 1907 1908 1909 1910 1911 1912 1913 1914 1915 1916 1917 1918 1919 1920 1921 1922 1923 1924 1925 1926 1927 1928 1929 1930 1931 1932 1933 1934

these municipalities from some 130 millions annually in 1902 to about one billion of dollars annually from 1927 to 1930 inclusive is largely due to the following factors: (1) The rapid increase in the growth of these cities as the result of the urbanization movement of the 1920's; (2) differences in price levels between the pre-war and post-war periods; (3) increasing assumption of responsibility for community services, such as water, light, gas, etc., by public agencies.

The movement from farms to cities which was conspicuous during the 1920's and reached a peak of more than one million persons in 1922, declined slightly thereafter for several years. Recently there has been a large increase in the migration to cities which is likely to continue, although probably not in as large numbers as occurred during the 1920-1930 period. As soon as permitted by their fiscal condition municipalities are also likely to further extend their responsibilities in the provision of community services. Consequently the revival of municipal construction may be very substantial in the future, subject, however, to certain important conditions such as the period over which municipal responsibilities for relief are likely to extend.

It will be observed from Fig. 7 that the decline in the volume of outlays has in no sense been due to the decline in net revenue receipts of municipalities, but rather to the proportion of the receipts devoted to permanent outlays. As a matter of fact, receipts in 1931 were slightly in excess of those for 1930, and were maintained at fairly high levels during the depression years.

Statistics of contracts awarded indicated some increases in municipal construction outlays during the past year. A large volume of work, however, has been withheld during the past five or six years and urgent needs exist in many cities for schools to provide for the largest number of children of school age on record, for major street resurfacing, for extensions to water supply systems, and sewage treatment plants, for express highways in nearly all of the larger cities and for many other improvements.

Fiscal condition of cities

Although tax collections were difficult in many cities for several years, delinquencies have now greatly improved. Some reductions in taxes upon real property have also occurred and total assessed valuation in all cities over 100,000 population has been reduced by more than 30 per cent over the period from 1930 to 1935. Total revenue from all sources, however, in nearly all municipalities is well maintained; this condition is likely to continue for some time.

Interest rates also influence the volume of municipal and other public construction although it appears at present that municipal outlays are being financed more out of current revenue rather than by borrowings. The present low interest rates appear to be particularly important in determining the volume of construction by public corporations engaged in operations which in many cases are revenue producing. Corporations of this type have also been created to facilitate construction work by municipalities prevented from further direct borrowings by debt limitation. It will be a fortunate outcome, however, if municipalities as a result of present experience adopt more widely the policy of providing a large part of general construction outlays directly out of net revenue rather than to continue to divert large sums to interest and other financing charges upon public indebtedness.

Relation to general business

Fluctuations in construction concern not only contractors, engineers, mechanics and others dependent upon this industry for their livelihood but also the general public through their highly important effect upon purchasing power.

The general purchasing power created by a release of funds for construction is very large and has been estimated at two to three times the original outlay. Thus, the primary reduction in total construction of 8 billion dollars from the 1925-28 level to the low point in 1933 very likely caused an additional secondary reduction in general purchasing power of as much as 16 billion dollars annually.

The close interaction of all aspects of economic life makes essentially impossible the designation of isolated factors as those of single cause and effect. Frequently a whole chain of consequences follow a given major change. An orderly release of funds for durable goods maintains purchasing power, which, in turn, influences economic demand, and this sustains expenditures for all types of commodities (including durable goods), a process with many further ramifications. Although this process is essentially continuous, the release of investment funds for construction, machinery, equipment, etc., comes at a particularly strategic point. Here expenditures are withheld or expanded to a degree impossible in the case of items such as food or clothing. Consequently durable goods expenditures, lie at a vital point along the sequence of events upon which economic stability depends.

The character of the period in which such an increase of funds is released is also of great importance. In a period of general contraction of credit and durable goods expenditures a substantial part of the purchasing power placed thereby in the hands both of corporations and of individuals is absorbed in the payment of debt. It is thus sidetracked and for the most part fails to continue to generate further activity. In such times as the present when interest rates are low and the future more promising, the expansion of durable goods activity is both a sign of renewed activity and a dynamic force tending to further enlarge many types of economic activity (including construction) through its large and widespread effect upon levels of income and general purchasing power.

Conclusions

These generally favorable prospects should not obscure the fact that total activity is still substantially under normal levels and should not be permitted to detract from the importance of making a concentrated effort toward the lessening of the violence of these fluctuations in the future. Fluctuations in economic activity cannot be wholly eliminated in the life of any people enlarging in numbers or in standards of living. Whenever people are free to choose what they will purchase with the funds at their disposal, production and consumption will not always be in perfect adjustment. Maladjustments arising from the decadence of old industries and the development of new ones, from disturbances in prices and interruptions in trade and commerce caused by war and similar catastrophes, also tend toward instability. The trends in the volume of construction and other durable goods outlays, however, may be stated to a considerable degree in terms of fundamental economic principles and measurable factors many of which are subject to some control. The provision of more adequate information regarding the present market and probable future demand for various types of construction, the establishment of sound economic practices in the financing of fixed improvements, the control of the expansion and contraction of credit in the general interest and the planning and proper timing of government construction, are some of the practical measures that have been proposed to lessen the violence of these fluctuations.

For a number of years gradual progress has been made in the enlargement of knowledge in this field, particularly in the form of improved statistics. During the past few years a number of measures such as those indicated above have also been adopted by public agencies as well as by private business. Repeated experience, however, particularly during the past decade, has demonstrated the urgent need of much fuller understanding than has at any time been available. This fundamental understanding leading to the adoption of carefully conceived long time measures, both public and private, is essential to the attainment of any substantial degree of stability not only in construction and other durable goods industries but also in general business.

Superflood Bulkheads Installed In Pittsburgh Department Store

Joseph Horne Co. prepared to resist 12-ft. head against its show windows by aluminum panels moved into place on trolleys—Supplements drainage and pump system in the basement

PITTSBURGHERS who happened to be downtown several weeks ago when the floodwaters of Allegheny River again invaded Duquesne Way and all but lapped over the door sills of the Joseph Horne Co. department store were treated to a preview of one of the most elaborate layouts of private flood fighting equipment in the country. Installed since the floods of last March devastated the first floor and basement of the store causing a loss of 1½ million dollars, the equipment was receiving its first test. In 1 hour and 40 minutes the building was rendered watertight to a height of 12 ft. above the street, corresponding to a 48-ft. stage on the Pittsburgh gage, 2 ft. above the floor stage of last March, 7.3 ft. above the previous record made in 1907 and 1 ft. above the estimated superflood level.

What the watchers saw was a pair of men in each of the 16 show windows. First they removed the decorative panels of the back wall, exposing an aluminum blukhead. Next they pushed this bulkhead, which was suspended from a trolley, up to a position behind the window glass and bolted it into place. Other aluminum bulkheads were brought from a storeroom to close up the door entrances. This was the visible activity. Behind it was an expensive planning and construction program that originated in a board of directors that was not disposed to give up a large investment in property, good will and shopping habits that had been built up during a period of 45 years in the same location. The floodwaters of last month did not rise above street level but the precautionary operation of the flood fighting devices gave assurance of security in the next superflood.

Original flood protection

Following the great 1907 flood in which the Joseph Horne Co. also suffered serious damage, a flood protection program was undertaken involving the installation of French drains and sumps beneath the basement floor, pumps for emptying the sumps and also steel bulkheads for the store front above the street. The pump equipment kept the building free from water during the flood periods of the subsequent 29 years, and at every flood threat the heavy steel bulkheads, requiring 15 to 20 men to handle them, were trucked across the river from a warehouse and stacked on the sidewalk ready for use. They were never required, however, until the 1936 flood arrived, unheralded by adequate warning, and then it proved impossible to get them from the warehouse in time. Water rose 10 ft. above the street (Fig. 2) broke in the doors and windows, inundated the first floor, and filled the basement, drowning out the pumps.

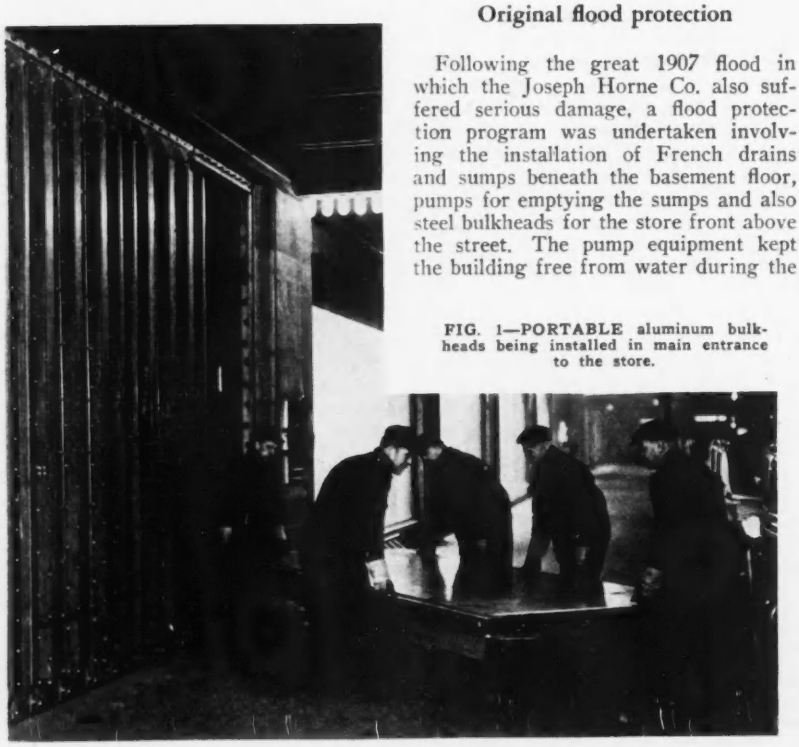


FIG. 1—PORTABLE aluminum bulkheads being installed in main entrance to the store.

The new flood protection plan

Flood bulkheads that would be on the premises at all times were immediately suggested and it was recognized that they should be of such type that a limited number of men could handle them. And to supplement the bulkheads the following other measures were undertaken:

1. Building of a waterproof sidewalk vault, adequate to resist a head of 12 ft. of water.
2. Sealing with masonry of all nonessential building openings below the 12-ft. water line.
3. Reinforcing the existing pumping and drainage facilities.
4. Installing fixtures in the main and basement floors of water-resistant metal and installing wheeled fixtures in the basement that may be rolled, merchandise and all, to the upper floors.
5. Organizing a flood brigade among the store force drilled to operate every detail of the flood protection plan.

The new aluminum bulkheads

The bulkheads that were developed, while similar in principle, are quite different in detail from the steel stoppage plates previously employed. They even vary in principle to the extent that the old plates were stored in a warehouse a mile away while the new ones are easily accessible at all times. The chief advantage of the new bulkheads is their light weight achieved by the utilization of ¼-in. aluminum plates of *3s* type

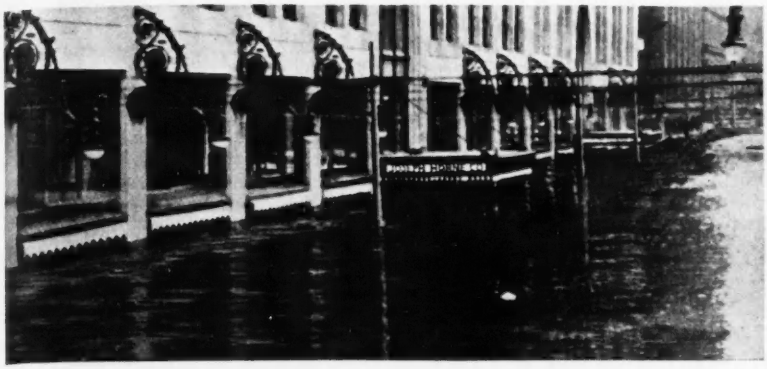


FIG. 2—WHEN FLOODS NEXT reproduce this scene of last March in downtown Pittsburgh, the merchandise of the Joseph Horne Co. will be dry and safe behind a wall of aluminum bulkheads.

and shapes of 17ST type. The light weight not only permits speed and ease of handling but it also allowed a greater height of protection without increasing the weight unduly.

There are in all five types of bulkheads: (1) rolling bulkheads; (2) vertical sliding bulkheads; (3) overhead hinged bulkheads; (4) fixed compression bulkheads; and (5) portable compression bulkheads.

The sixteen windows are protected by rolling bulkheads (Fig. 3) which are suspended from four-wheel, ball-bearing trolleys mounted on ceiling tracks extending from the rear of the windows—where the bulkheads hang when not in use—to a flanged steel frame 10 in. behind the plate glass window. Bolts premanently fixed to this frame engage holes drilled in the aluminum bulkhead plate. Nuts, ready for instant service, are stored in pockets built into the rear of the bulkheads. When the metal barriers are in place against rubber-gasketed frames, an electric power wrench is used to tighten the nuts.

Small inlets, located below the windows, allow water to rise between the glass and the aluminum, thus equalizing water pressure on both sides of the plate glass windows to preserve them from breakage. Also, an attached floating wooden barrier rises on the outside with the water and diverts floating debris.

All rolling bulkheads are about 9 ft. high and they range in length from 8 to 24 ft. The largest one weighs 1360 lb. The $\frac{1}{4}$-in. plates are stiffened on the back by 4x3x$\frac{7}{16}$-in. angles placed vertically on 16 in. centers. In addition a horizontal diaphragm of two angles is attached about 3 ft. from the bottom to take the reaction from inclined pipe braces that run back to the rear of the show window. This diaphragm forms the pocket for the nuts referred to above. Three edges of the bulkhead plate are stiffened by 2$\frac{1}{2}$x$\frac{3}{8}$-in. bars, and a 4x3x$\frac{3}{8}$-in. angle is used along the top.

At one of the entrances and for a service door, vertical sliding type bulkheads are used. These are counter-balanced and merely drop into place. Steel is used for the service door unit, and aluminum for the one at the entrance. When in position, these two bulkheads require only calking with oakum to make them watertight.

At the shipping platform, facing the Allegheny River across the street, continuous aluminum bulkheads of the overhead hinged type are installed. (Fig. 4). These are merely dropped into vertical position and bolted tight with an electric wrench. The $\frac{1}{4}$-in. plates of these bulkheads are stiffened with 4-in. 2.72 lb. I-sections, 15 in. on centers. The edges are stiffened by 2$\frac{1}{2}$x$\frac{3}{8}$ in. bars and in addition 3x3x$\frac{1}{2}$-in. angles are used along the top and bottom.

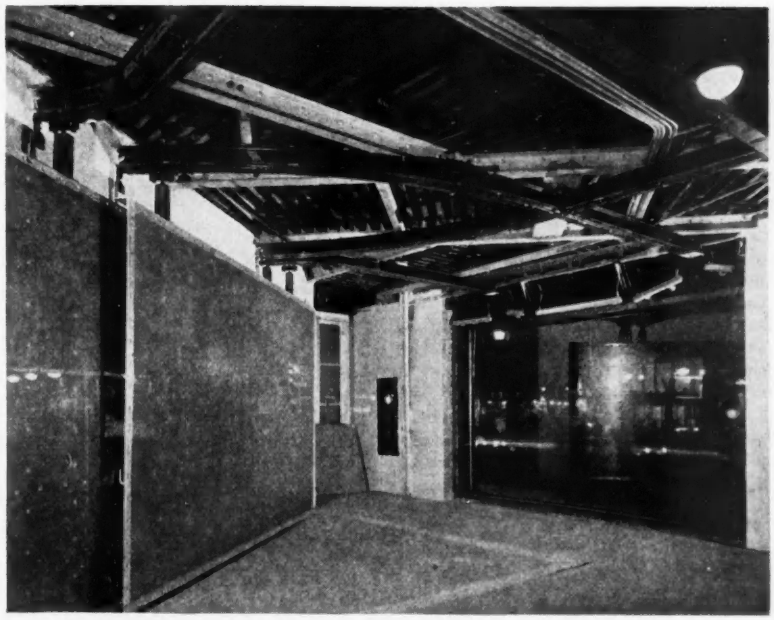


FIG. 3—FLOOD PROTECTION MACHINERY in a show window. Aluminum bulkheads always hanging from trolleys in the backwall can be pushed forward against the windows and made watertight.

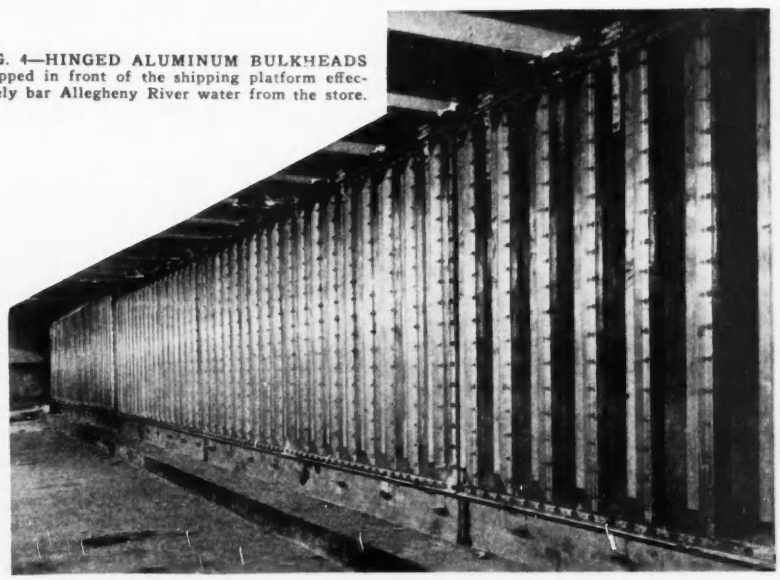


FIG. 4—HINGED ALUMINUM BULKHEADS dropped in front of the shipping platform effectively bar Allegheny River water from the store.

Two fixed compression bulkheads that close service entrances are made of steel because neither appearance nor transportation were vital factors. They open out, but are fastened from within. Only calking is required to make them watertight.

Five customer entrances are closed with portable, vertical compression bulkheads which are installed in sections, each door consisting of four sections constructed of aluminum alloy plate and structural shapes (Fig. 1). When not in use, these bulkheads are stored in an easily accessible room inside the building. Light in weight, they are quickly moved to location, raised into position, bolted tight to an existing frame and calked with oakum along the bottom slot into which they slide. Each section of these bulkheads is 5 ft. long by 12 ft. high. Again ¼-in. plate and 2½ x ⅜-in. edging bars are used but the stiffeners consist of two 5-in. 2.38 lb. channels placed back to back and spaced 15-in. on centers.

Strengthening the sidewalk

The old sidewalk with vault lights was replaced with a new solid slab consisting of 12 in. of reinforced concrete and a 3-in. cement-mortar wearing surface separated by a 5-ply waterproof membrane composed of 2 layers of fabric and 3 layers of tar paper. Both the slab and the waterproofing are continuous up the side of the building to the bottom of the window frames which are embedded in the masonry. The floors of the show windows are also of reinforced concrete.

In addition to this watertight sidewalk table around the building, every non-essential wall opening below the 12-ft. flood line was closed permanently with brick, stone and concrete. As an example, leaded glass windows in a main floor restaurant were replaced with masonry construction, and artificial illumination and air conditioning substituted for natural light and ventilation.

The basement drainage system

All foundation walls are waterproof and the basement floor is a 12-in. concrete slab, topped with a 3-in. cement fill and a 1-in terrazzo finish. Incorporated in this slab is an efficient system of French drain channels, sumps and cast-iron pipes installed after the 1907 flood and repaired and strengthened during the recent overhauling. The drain channels, of 4 in. open-joint tile pipe, collect water as it infiltrates through the soil, and deliver it to one of 11 sumps located at intervals below the basement flood. From these collection stations the water flows through 12 in. cast-iron pipes to the main sump which is 12 to 15 ft. deep, and 20 ft. long by 6 ft. wide. Pumps with a total capacity of 10,000 g.p.m. lift the water from this main sump into the street. The pipe outlets rise with the water so that the discharge is always above water level, thus reducing back pressure. The pumps are variously of steam-siphon, steam-turbine and electrically-operated types.

As stated previously, flood crews have been organized among the store force and drilled in every detail of installation of the flood protection devices. Also, fixtures, merchandise, etc., are so planned that they either will not be damaged—being constructed of steel, bronze, glass and aluminum—or they may easily be transported on the elevators to upper floors. All in all, the new flood protection system is deemed adequate to protect the store from a greater flood than has ever been experienced. Tests have demonstrated that the entire building can be sealed in one and one half hours and it has been estimated that the basement and main floors can be cleared of merchandise in three hours more.

For the Joseph Horne Co., I. W. Truxell is store architect and W. W. Boyle is building superintendent and supervising engineer. The remodeling of the flood protection system was handled by Janssen & Cocken, Pittsburgh architects, and the installation work was done by the Mellon-Stuart Co., Pittsburgh, as general contractors.

Government Held Responsible For Its Delays to Contractor

U. S. Court of Claims finds that a contractor on government work may collect damage for delays due to the government's agent

A DECISION made by the Court of Claims of the United States on Dec. 7, 1936 in a suit growing out of the construction of the post office and court house at Trenton, N. J. (noted briefly in *ENR*, Dec. 18, 1936, P. 874) is of special significance because of its clear statement of a contractor's rights under a contract with the federal government when delays due to failure of the government's agent to live up to his part of the contract cause added expense to the contractor. Of special significance is the court's finding that the Comptroller General cannot overrule the Supervising Architect of the Treasury when the latter finds a contractor's claim to be correct because the Comptroller General is not a party to the contract.

The suit (Court of Claims No. 42803) was brought by the Karno-Smith Co., being represented by Frederick Schwertner of Washington. Judge Whaley, after stating the court's finding fact, rendered the following opinion in which Judges Williams, Littleton, Green and Booth concurred:

Opinion

"The plaintiff on Sept. 12, 1931, entered into a contract with the defendant by which the plaintiff agreed to furnish all labor and materials and to perform all work required for the construction of the United States Post Office Building and Court House at Trenton, N. J., except elevators and foundations, for the sum of $749,500 according to specifications, schedules, and drawings which were made a part of the contract. The building was to be completed within 480 calendar days after the date of receipt of the notice to proceed. On Sept. 24, 1931, the plaintiff was notified to proceed, which fixed the date of final completion as Jan. 16, 1933. The defendant furnished the site and also the concrete foundations for the building, which was to be a five-story structure, with the exterior front and two sides of oolitic limestone and ornamental terra cotta, and the back principally of limestone and brick. The interior of the building was to be constructed principally of structural steel and reinforced concrete floors.

"Shortly prior to the commencing of the work, the plaintiff prepared a schedule of its contemplated progress of each class of work and furnished a copy of it to the defendant. Each of plaintiff's subcontractors was also furnished a copy and was required by the plaintiff to adhere to the schedule of his own particular work. This schedule of progress plaintiff planned to adhere to and it was an essential part of the contract arrangements, expected cost, and the amount of its bid. Under this progress schedule the steel work was to begin on Sept. 25, 1931, and be completed in three months; the limestone and brick work were to begin about Jan. 4, 1932; the terra cotta work a day or two afterwards; and the limestone, brick, and terra cotta work were to be finished the end of March 1932. The schedule showed that all of the contract work was to be finished by the end of Sept., 1932. The facts show that the plaintiff would and could have substantially adhered to this schedule had it not been for the delays caused by the defendant. The building was completed and accepted by the defendant in the early part of February 1933, and the plaintiff has been paid the contract price together with certain extras which are

not in dispute, but the plaintiff reserved its rights in reference to the items herein enumerated for which it claims remuneration.

"The plaintiff's claims fall into two classes. The first is for damages caused the plaintiff due to the fact that the defendant delayed the plaintiff in the completion of the work. The second class consists of items for extra work performed under the terms of the contract for which the plaintiff claims additional compensation.

"The government agreed to furnish the foundations but when the plaintiff entered upon the work it was found that the foundations were out of place from three inches to two feet. The government employed the plaintiff to correct these errors and defects and paid the plaintiff for this work and allowed an extension of time of 13 days for the completion of the contract. During these 13 days, while the foundations were being put in proper alignment, the plaintiff was prevented from proceeding with its work and the orderly progress of its work was thrown out of schedule; the superintendent, the plant, and the workmen were idle; and an additional expense was placed upon the plaintiff in the sum of $1,635.01. It is too well established to require citation of authority that the government can be required to make compensation to a contractor for damages which he has actually sustained by defendant's default in its performance of its undertaking to him. *United States* v. *Smith,* 94 U.S. 215. The defendant does not deny this proposition but contends as a defense that the plaintiff in March 1933, wrote a letter to the defendant in which it stated that no claim for loss would be made on this item. At that time the contract had been completed and the plaintiff was endeavoring to obtain a settlement of its outstanding claims against the government. None of its claims were allowed. It is sufficient to say that there was no consideration for this surrender and it was made solely in an attempt to arrive at a settlement. The mere fact that the government had granted an extension of time for the completion of the contract, due to the fact that it had delayed the plaintiff, does not relieve it of the responsibility for the damages incurred by the plaintiff due to these delays. *Edge Moor Iron Company* v. *United States,* 61 C Cls. 392; and *Julius Goldstone et al.* v. *United States,* 61 C. Cls. 401. The plaintiff is entitled to recover on this item.

Delays due to lack of plans

"About a month after the plaintiff had entered upon the work, it notified the defendant of the subcontractor to whom it had given the contract for the manufacture of the terra cotta and requested that full size drawings for and models of ornamental, plain, and colored plaster for the terra cotta work for the exterior of the building, which were to be furnished by the government, be delivered to its subcontractor. The defendant delayed in furnishing these drawings and models and the plaintiff repeatedly protested against the unreasonable delays and warned the defendant of the loss which would result, stating that it would hold the defendant for reimbursement of all damages it sustained by reason of the government's failure to furnish them. The government admits that it delayed the plaintiff 62 days in the furnishing of these drawings and models and granted an extension of time for the completion of the contract for this period. Owing to the disruption of its progress schedule and the idleness of its force of workmen and plant, the plaintiff incurred an additional expense of $9,657.74. In addition to this overhead, the plaintiff had contracted with its subcontractor, who had the contract for the placing of the limestone front, for the use of its scaffolding for the purpose of putting in place terra cotta work. Owing to the delay of the government in furnishing the drawings and models for the terra cotta work, the limestone had been placed in position and the scaffolding had been removed, and the plaintiff was put to the additional expense of erecting a new scaffolding in the sum of $984.34. Where the government agrees to perform a certain work or to furnish certain articles and fails to carry out its part of the contract, it is liable for the actual damages resulting from its failure to perform. It is too obvious to need argument that the government is responsible for the actual damages occasioned by the delay in furnishing these drawings and models. The cost of the new scaffolding is a part of the damages suffered and is includable in the amount plaintiff is entitled to recover, occasioned by the delay of the defendant. The plaintiff is entitled to be reimbursed the amount of $10,642.08, being the actual damage sustained.

Contract violates code

"We next come to the three items which are for work within the terms of the contract but for which the plaintiff claims extra compensation by reason of the fact that the specifications furnished by the government did not comply with the code requirements of the city of Trenton. In all three instances the claims are under $500 and therefore do not require authorization in writing. We do not feel that it is necessary to state the facts in each of these items as they are fully set out in the special findings of fact and, therefore, it is only necessary to say that the plaintiff had the right to assume that the specifications as drawn by the government complied with the municipal code of the city in which the building was to be erected and the contractor could not be expected to violate a law of the municipality in order to keep within the specifications of the contract. In each instance, the contracting officer's representative orally instructed the plaintiff to comply with the municipal code, but in each instance payment was subsequently refused for the extra work performed. Upon the completion of the building, this work was accepted by the government and the government has received the benefit of it. The plaintiff is entitled to recover these three items, amounting to $279.00, $370.21, and $159.94, or a total of $809.15. *Suburban Contracting Company* v. *United States,* 76 C. Cls. 533; *Venable Construction Company* v. *United States,* 114 Fed. 763; and *Griffiths* v. *United States,* 77 C. Cls. 542.

"The next claim made by the plaintiff is for the furnishing of heat for 30 days from Nov. 15 to Dec. 14, 1932, in the sum of $1,200. The plaintiff had contracted to furnish temporary heat as necessary to protect all work and material against injury and cold weather, and when called on to furnish heat for the period above mentioned it protested but supplied the heat. The contention is made that if the Government had not delayed the plaintiff 13 days in the preparation of the foundations and the 62 days in furnishing the drawings for the terra cotta work, the building would have been completed before the cold weather had set in and therefore the heat would have been unnecessary. The facts clearly show that the necessity for the furnishing of this heat arose because of the delays occasioned by the defendant and without these delays the building would have been completed and turned over to the government before cold weather had set in and the plaintiff would not have been called upon to furnish this heat. A claim was made for the reimbursement of this additional expense, investigated by the Supervising Architect and referred by him to the Comptroller General, who disallowed it. It was the duty of the Supervising Architect under the terms of the contract as representative of the contracting officer to make a decision on the merits of the claim. The Comptroller General was not a party to the contract, and his decision amounted to a nullity. Where the contracting officer fails to perform the duties imposed upon him by the contract, it is the duty of the court to perform this service and pass on the legal rights of the plaintiff.

"In our opinion, the furnishing of this temporary heat by the plaintiff would have been unnecessary if plaintiff had not been delayed by the government in the performance of its work, and, having been delayed by the government, it is entitled to recover the actual damages it has sustained, which in this case is the additional expense it has incurred. The plaintiff is entitled to recover on this item, the amount of $1,200.

FIG. 1—THE GREAT SIZE of the All-American Canal is shown effectively by this view taken where the canal capacity is 15,155 sec.-ft. The width of the bottom here is 100 ft.

All-American Canal Progress

The 85 per cent of excavation completed Jan. 1 includes most difficult portions—Typical crossings and overpasses—Three years' work yet to be done on project

EXCAVATION was about 85 per cent complete by the end of 1936 on the main line of the All-American Canal which is 80 miles long and involves moving some 60,000,000 cu.yd.; major problems such as suitable dragline buckets, combating dust on rolled fills and meeting difficulties arising from high temperatures and low humidity, had been solved satisfactorily. Also there has been opportunity to observe the effect of wind storms on the type of construction used through the sand hills, a location which has been the subject of much speculation. The first excavation contract (for about 30 miles of main canal) was begun in the fall of 1934 and construction operations extending over about three years more will be required to complete the canal and appurtenant structures, including the diversion dam and desilting works.

The Bureau of Reclamation functions in the construction program just as it did at Boulder Dam. When the works have been constructed and the canal has been primed and seasoned it is to be turned over to the Imperial Irrigation District for operation. In the four power drops involved at different points along the canal the bureau is putting in the substructures only, and other construction at these points will be in the hands of the irrigation district. The All-American Canal project has been described previously in *Engineering News-Record*, Oct. 18, 1934, p. 488 and Nov. 29, 1934, p. 688.

The canal capacities are as follows: 15,155 sec.-ft. for the 14.7 miles from the Colorado River intake to Siphon Drop, where 2,000 sec.-ft. is delivered to the Yuma project; then 13,155 sec.-ft. to Pilot Knob, where a power drop and a wasteway into the Colorado River are proposed (the wasteway only to be constructed at the present time). Thence 10,155 sec.-ft., decreasing by successive stages as laterals are taken off. The 155-sec.-ft. apparent in all these figures is the allotment to the city of San Diego, which is to be continued in the branch canal taking the most direct route to the west side of Imperial Valley nearest to San Diego. No work is being done now on the Coachella Valley branch canal, 130 miles in length.

Excavating with 16-cu.yd. buckets

Standard sections of the main canal range from a base width of 94 ft. in rock cut up to a bottom width of 160 ft. in earth sections. Embankment slopes vary from $\frac{3}{4}$:1 in rock cuts to as much as 3:1 for rockfill on the outer surface of some embankments. For the most part the canal has side slopes of 2:1. The yardage for the average canal section is large enough to justify the greatest care in developing economical handling methods.

The several contractors have used much the same type of excavating equipment, namely, the walking draglines that were used extensively in levee construction along the Mississippi River. Three of these machines have booms about 175 ft. long and the main operating engines are 400- or 450-hp. diesel units. At the outset there was considerable experimental work on the size and shape of buckets. Mississippi River experience was not a criterion for the All-American Canal job in bucket design because in the earlier case the material handled was wet and heavy, far different from the light and extremely dry fines of the desert. As the result bucket capacities for the canal job were increased to 12, 14 and finally 16 cu.yd.

Trimming up the slopes and the berm is done with smaller units; in some cases the final surfacing of the inside slopes is done with a heavy steel cable dragged along the canal sides by two tractors, one on the berm and one in the canal bottom.

Particularly in the sand dunes, where cut depths range up to and beyond 100 ft., there has been much speculation as to the most successful method of keeping sand out of the canal. Because the sand dunes have a tendency to move forward or drift with the wind there was some fear that they might have serious effects on the canal. Four methods of preventing objectionable sand drifting were suggested: (1) spraying adjacent slopes with oil, (2) use of vegetation as a surface anchor, (3) spreading a layer of coarse material to prevent winds from blowing the surface, and (4) use of a wide berm to afford the maximum protection as well as a space from which to remove drifts if necessary before the sand gets into the canal itself.

With a view to studying the drifting sand problem without unnecessary

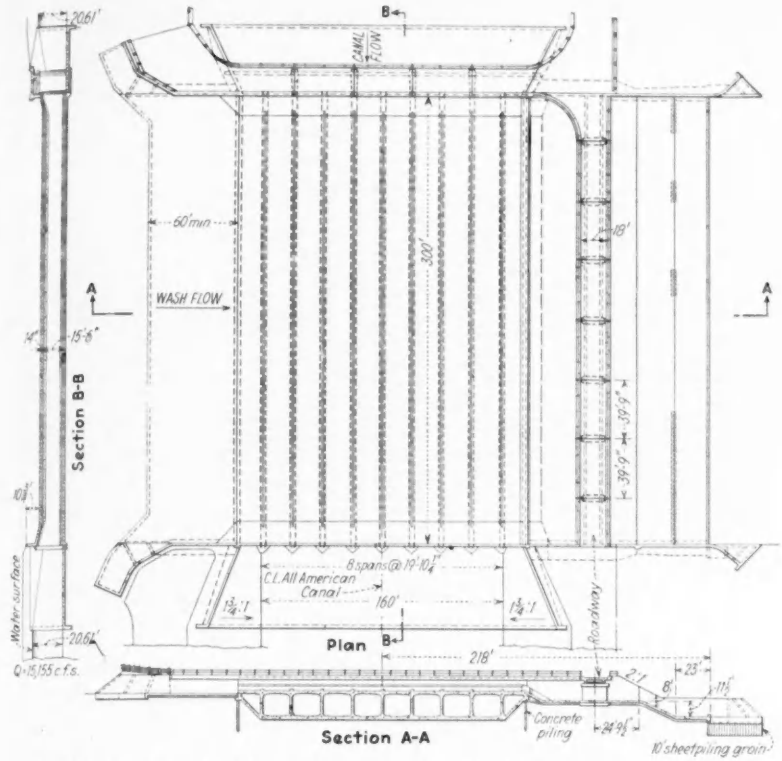


FIG. 2—SIPHON DESIGN showing details of structure that conveys the main canal under Picacho Wash.

expenditure, the policy in construction through the first part of the 10½ miles to be built through the sand dunes has been to use a wide berm (24 ft. instead of the 20 ft. originally planned) and to leave openings at berm level through the spoil banks (some 40 to 45 ft. high) which parallel the canal. Because these openings are spaced not more than half a mile apart it would be possible to move out through them any drifts that accumulate on the berm. Another expedient, largely a matter of the sequence in which spoil was deposited, was to see that the coarser material excavated went on top of the spoil bank, thus decreasing the likelihood of dislodgment in wind storms.

The upper end of the canal built through the sand hills has been completed for about a year and during that time there has been opportunity to observe the effect of sand storms. Sand has not blown into the canal, no drifts have appeared on the berms, nor has there been much tendency for the sand to pile up against the spoil banks. Further observation of the section through the dunes will be made. In the sand hills the design is for a velocity of 3.75 ft. per second, intended to be non-scouring and non-silting. Where the location traverses very fine sand the section was over-excavated and in some sections layers of coarser material were put in.

Compacting canal lining

At several places, where the lower bank was in partial fill or built up of porous material, a compacted lining of selected material is being constructed. Wherever this is done the initial width of the canal was made wider than the finished width by an amount sufficient

FIG. 3—DRAGLINES operating large buckets (up to 16 cu.yd.) do most of the excavation. In this view the bucket is dumping on a spoil bank of typical height. The dragline is widening the cut to the full section.

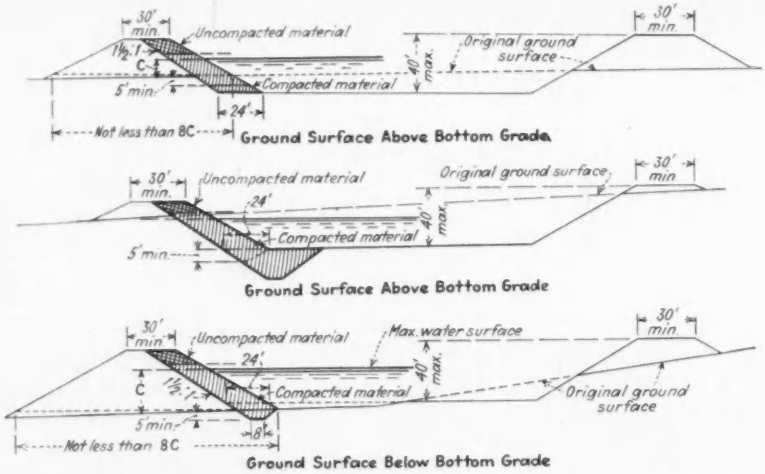


FIG. 4—CANAL LINING of three types are shown in these sections which indicate the relation of depth of the compacted fill to original ground surface.

to allow space for a compacted earth blanket or lining along the built-up embankment. In addition, excavation was carried down in some cases as much as 25 ft. below canal bottom to get into firm impervious material. Ordinarily the width of the layer of compacted material placed in these sections was 24 ft. at the level of the canal bottom, narrowed thence to 19 ft. at water level. The full normal thickness of embankment was placed outside of and in addition to the lining blanket.

The several stretches that make up this 7.5-mile total length occur between 5 and 23 miles below the intake. In this part of the line the canal section is of maximum size. More than a million cubic yards of compacted material has been placed in these lining operations. Practically all of the specially lined sections now are complete.

Specifications for these compacted linings required "the best practicable degree of compaction, impermeability and stability" to be attained with a mixture of clay, sand and gravel proportioned for maximum density and excluding stones having a maximum dimension of more than 5 in. This material was deposited in horizontal layers not more than 6 in. thick (after rolling) and was compacted by tamping rollers exerting pressures of 250 lb. per sq.in. "The optimum amount of water for compacting purposes within practical limits" was required

FIG. 6—IMPERVIOUS LINING in a layer 24 ft. wide is being compacted on the outer embankment. This lining is a rolled earthfill in all respects equal to highest standards for earthfill dams.

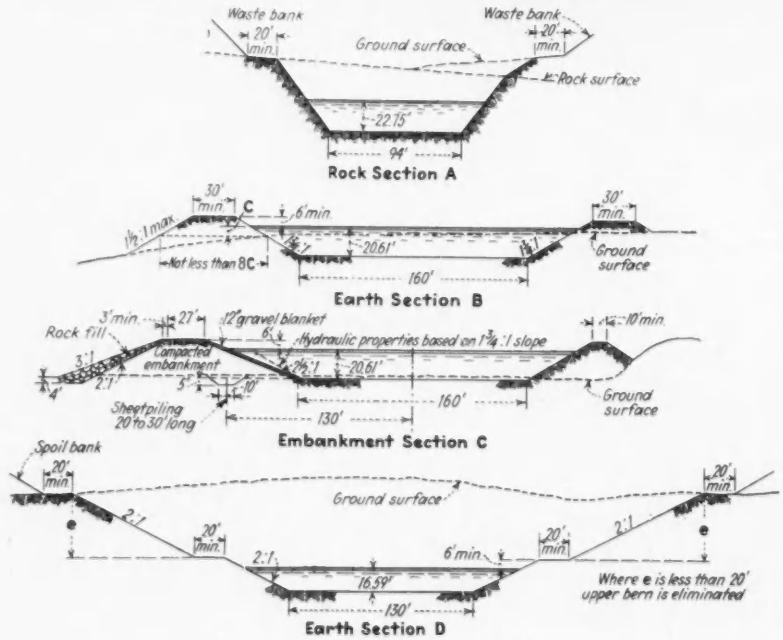


FIG. 5—TYPICAL CANAL SECTIONS for various conditions of cut and fill.

to be uniformly distributed throughout each layer.

At the start an endeavor was made to apply on the fill the entire amount of water required. In the borrowpits the dust became so thick that truck drivers and others could not see to operate effectively. An even greater difficulty was that water sprinkled on the extremely dry material in the fill formed a surface seal which required repeated disking to obtain the desired moisture content.

This condition was remedied by wetting the material before excavation: surface layers were wetted effectively by flooding before excavation and deeper layers were reached by jets, using a pressure of 100 lb. per sq.in. Jets delivering 250 g.p.m. were put down about 5 ft. on a spacing of 8 to 10 ft., and in this way effective wet-

HYDRAULIC PROPERTIES OF CANAL SECTIONS IN FIG. 5

	Area (sq.ft.)	Velocity (ft. per sec.)	Quantity (sec.-ft.)	Hyd. Radius	Kutter's n	Slope
Rock Section *A*.....	2525.8	6.00	15,155	16.74	0.035	.0004207
Earth Section *B*.....	4041.3	3.75	15,155	16.63	0.025	.0000826
Embankment Section *C*...	4041.3	3.75	15,155	16.63	0.020	.0000528
Earth Section *D*.....	2708	3.75	10,155	13.26	0.020	.0000760

ting of pit material for depths of 12 to 20 ft. was obtained. Material so treated was placed very effectively in the fill, and the only sprinkling required after spreading was largely that required to replace the loss by evaporation in handling. Whenever the compaction from the operation of trucks tended toward concentration in layers, disk harrows are used to break up the crust. Contractors reported that before wetting prior to excavation, dust damage to equipment working in the pits more than offset the cost of the flooding and jetting.

With water applied both in borrowpit and on the fill some 8 or 9 per cent of the total 12 per cent required was found in the material as excavated and the remainder was applied by sprinklers on the fill. Laboratory tests made with this material (from which everything over ¼ in. size had been screened out) showed that for a pit run averaging 100 to 104 lb. per cu.ft. the compacted density was about 119 lb. per cu.ft. These figures are for dry density both in pit and in fill. The fill compaction samples were taken after twelve passes of the roller developing the pressure of 250 lb. per sq.in.

There is only one exception to the method of earth lining as described in the foregoing. This is the length of 1.6 miles adjoining the upper end of a rock cut, where the entire lower bank was compacted by the methods described and a heavy blanket of riprap was placed on the lower embankment.

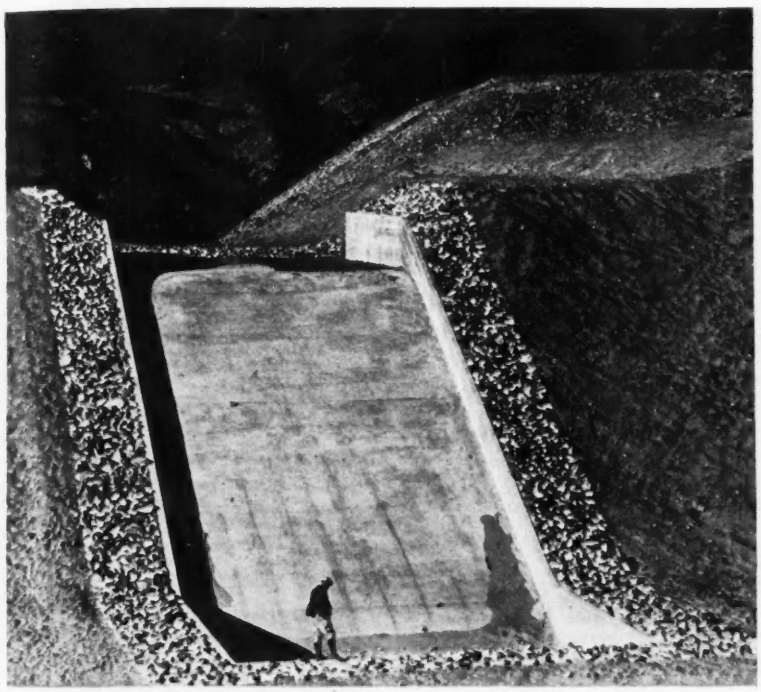


FIG. 7—TYPICAL INLET into the main canal. Where the drainage basin is less than 1 sq.mi. storm flow is made tributary to the main canal by means of a concrete structure designed to prevent scour.

Incidental to constructing the canal itself numerous structures are involved where railroads or highways must cross over the canal or where flood channels from drainage basins at higher levels much be carried over, under or into the canal.

The method of providing runoff channels had to be varied somewhat with topography and with the size of the drainage areas involved. Where areas less than 1 sq.mi. were tributary the practice was to provide an inlet structure discharging into the canal. These structures ordinarily consist of a concrete apron with a stilling basin to prevent erosion at the lower end (Fig. 7). Drainage areas of the intermediate size in general were provided an outlet in the form of an overchute or flume built on piers across the canal above water level. Where the largest drainage areas were involved it was found cheaper to put the main canal in a siphon beneath the bed of the transverse stream.

Of these structures the more novel is the type involving a flume built across the canal. There are six of these altogether very similar in design. The largest of them, typical of the others, is the one at Picacho Wash which flows in an open channel 300 ft. wide across the top of the canal. The piers supporting this flume together with the bottom of the flume and the floor of the canal constitute multiple barrel box culverts through which the main canal flow passes. (Fig. 2).

One of the difficult design requirements upon structures of this type is a provision for extreme temperature changes in the concrete slab, which is exposed to the desert sun for long periods at a time. In general the top slab is designed to slide on the end walls, and the vertical walls or piers supporting the top slab are expected to be elastic enough to allow for this movement incidental to expansion.

There are ten locations where provision must be made for transverse stream flow. Four of these have siphons of special design involving depressions in the main canal; the other six do not involve main canal depressions and are merely covered parts of the canal. The several crossings of railways and highways in the vicinity of Calexico do not involve novel features. There is a double-barrel steel siphon across New River, west of Calexico. Wasteways which provide for spilling water as a means of decreasing the flow or unwatering the canal are provided at Pilot Knob and at New River, with capacities equal to the full flow of the canal. Partial spillage is provided for at the Alamo canal.

Work on the All-American Canal is under the general direction of the U.S. Bureau of Reclamation, R. F. Walter, chief engineer. R. B. Williams is construction engineer at Yuma and Grant Bloodgood is resident engineer in charge of all work on the canal.

Argentina Capitol to Extend Storm Drainage System

FLOODED STREETS after heavy rainfalls in Buenos Aires, causing traffic interruption for hours and necessitating the use of small foot bridges at street crossings, will be eliminated by the construction of a $20,000,000 extension of the separate storm drainage system. Bids for the present work, which is part of a comprehensive drainage plan adopted in 1919, will be taken in the latter part of February. Further development is contemplated in parts of the city not covered by the present contract. The work is being carried out under the direction of the National Sanitary Works, Calle Charcas, Buenos Aires.

FIG. 1—OLD RUBBISH DUMP is furnishing the fill to transform 800 acres of marshland into a World's Fair site in New York.

Refuse Disposal Developments

Design and operation of incinerators are constantly being improved, the hog feeding method of garbage disposal is popular, and sanitary-fill procedure has won approval in some places.

NOTING that there is more interest today in the construction of incinerators than there has been for some time, and that hog feeding of garbage has become more important because of higher prices for corn and pork, the committee on technical aspects of refuse disposal of the American Society of Civil Engineers, in a report presented to the Sanitary Engineering Division of the society on Jan. 21, broadly outlined developments in municipal refuse disposal. This report follows one of last year which contains definitions of material and a statement of the status of refuse disposal in the United States and Canada. The committee includes H. P. Eddy, Jr., chairman, H. G. Baity, H. T. Cortelyou, F. E. DeMartini, W. N. Frickstad, Harry Goodridge, L. G. Williams, and F. C. Tolles.

The following is a summary of the committee's report:

Incinerator progress

Technical progress in refuse incineration has been evidenced in better furnace design, elimination of odors, reduction in hand-labor operations for charging fuel and removing ashes, and utilization of waste heat for steam generation. Better understanding of fuel requirements in burning garbage and the maintenance of deodorizing temperatures has eliminated objectionable features that attended many of the earlier incinerator installations. More consideration has been given to details of refuse furnace design based on sound mechanical engineering principles, with the result that maintenance costs have been lowered and the life of the structure has been increased. Automatic temperature control devices have recently been installed in a few plants. At Washington, D. C. and Newton, Mass. this control is obtained by varying the admission of secondary air; in the new Rochester plant provision is being made for automatic control of the main damper as well.

Chimney design has been greatly modified in recent years. With high temperatures and where flue gases are not cooled by passing through boilers, it is necessary to line chimneys with refractory material. Because of wide variations in gas temperatures, it has been found advisable to provide a wrought iron corset where independently supported linings are used. In addition a reversible target wall for the bottom portion of the chimney is commonly provided.

Conditions have been improved in the handling of ashes from incinerators. Until a few years ago ashes were customarily raked from the grate directly on to the stoking floor. Clouds of hot dust and disagreeable smoke filled the stoking room on such occasions. Later, dumping grates were provided by means of which the ashes were dropped into pits below the stoking floor, for subsequent removal into wheelbarrows or cars in an ash tunnel or basement. The next improvement came in providing ashpits with quenchers (either for continual or intermittent use) and water-sealed gates. With the water-sealed gates provision has been made for operating the mechanism either by oil rams, or, in smaller plants, by hand ratchet wrenches. Substitution of electric motor-operated ash trucks running in the tunnels from the pits to a skip hoist was a further improvement. Facilities in modern plants now permit motor trucks to be filled directly under the ash gate, thus eliminating the rehandling operations heretofore required.

In plants burning very dusty material, such as mixed refuse or rubbish, with a large percentage of household ashes, consideration is being given to the elimination of dust in the receiving bin. In designs by the Department of Sanitation in New York City, and elsewhere, provision has been made for capturing this dust at the top of the bin wall.

Waste heat utilization

In several plants built about 1907, boilers were installed for utilizing the heat from combustion of refuse. These plants performed satisfactorily for many years, most of them up to the present time. At the recently completed Providence, R. I. plant waste heat boilers are used to generate electricity for operating an adjacent sewage treatment plant. The Manchester, N. H. plant, now under construction, is provided with a boiler capacity of 11,000 lb. of steam per hr., and the steam will be used in a nearby asphalt plant. New

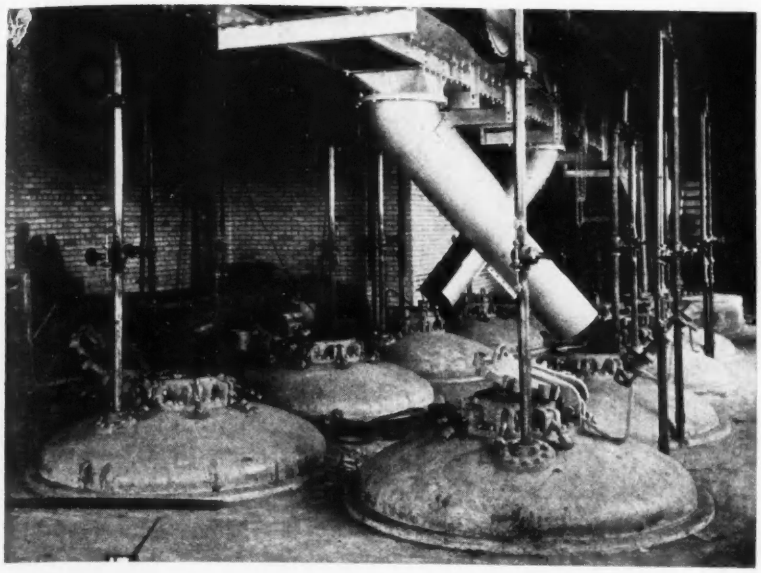


FIG. 2—GARBAGE REDUCTION unit at the Harrowgate incinerator, Philadelphia. At this place garbage is cooked by steam, then dewatered by hydraulic presses and finally burned; grease is reclaimed from the liquid.

York City is said to be negotiating with a private concern for the sale of steam from an incinerator now under construction. The new Rochester incinerator will generate about 50,000 lb. of steam per hr.; this will be used in the operation of a garbage reduction plant and it is expected that surplus steam may be sold to a local electric utility company.

There appears to be more interest today in the construction of incinerators than there has been for some time, although it is probable, stated the report, that if federal financial aid were curtailed many of the contemplated projects would be postponed.

Reduction and salvage

The trend in garbage reduction is said to be toward simplification of process, with less attempt at high recovery where it is likely that the revenue from the additional recovery may not justify the cost. Much tankage was burned as fuel under boilers or disposed of by filling waste land during the period of low prices resulting from the recent economic depression. At the present time, however, there is said to be a good spot market for tankage.

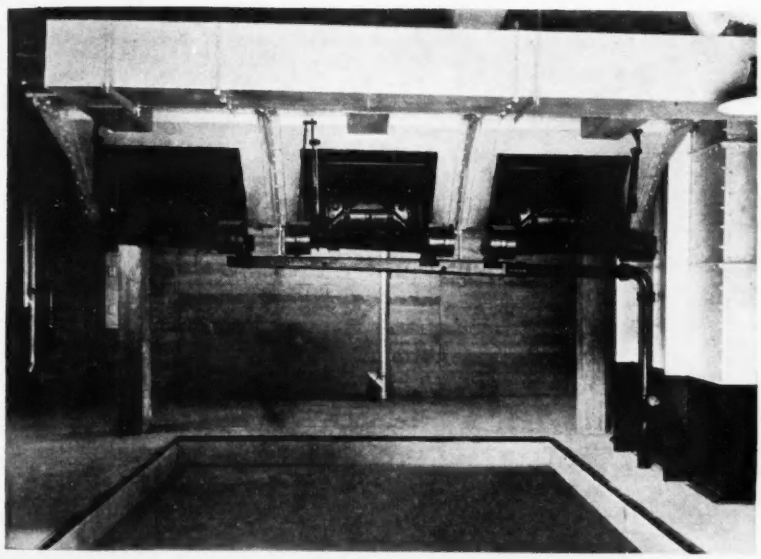


FIG. 3—ASH HANDLING FACILITIES have been greatly improved in new incinerator construction. This view shows water-quenched hoppers under the new Columbus, O., plant, where ashes are dumped directly into motor trucks.

FIG. 4—THE SANITARY FILL METHOD of refuse disposal at San Francisco where a daily load of 500-700 tons of municipal waste is dumped, spread, and covered with earth.

Rochester, N. Y. will discontinue operation at its rubbish salvage plant when the new steam generating incinerators are completed in 1937, thus adding another city to the list of those who have abandoned this process.

Hog feeding important

Hog feeding has become of more importance as a means of garbage disposal, says the report, due to the current high price of corn and pork. The city of Los Angeles recently received bids for a three-year contract for disposal of hog feeding of about 10 per cent of the city's garbage. The contractor's bid was based on a price of $1.11 per ton for residential type garbage, with hog prices ranging between 9 and 11 c. per lb. in the local market. The sale price of the garbage varies with the price of hogs; under the proposed contract, the buyers would pay nothing with hogs selling for less than 5c. per lb., 30 per cent of the base price with hogs selling between 5 and 7c., 65 per cent 7 to 9c., 100 per cent from 9 to 11c., 135 per cent from 11 to 13c., 170 per cent from 13 to 15c., and 225 per cent of the base price on hogs sold for more than 15c. per lb. In the fiscal year ending June 30, next, the city of Los Angeles will receive an income of about $175,000 for its garbage, or about 90c. per ton.

Garbage grinding

In St. Louis grinding of garbage and its discharge with sewage into the Mississippi River continues at the first station which was put in operation early in 1935, and four new grinding stations are now either in service, under construction or contemplated. (*ENR* Jan. 14, 1937, p. 58). At Durham, N. C., grinding garbage and treating it with sewage continues, but no new installations have been reported.

Use of individual, household garbage grinders, has been approved by some city engineering departments and not approved by others, said the committee. Even with greatly reduced prices made possible by mass production, it is doubtful if the number of such units installed will greatly influence the problem of sewage plant operators in large cities; in some of the small, wealthy suburban communities, however, they may become a factor of importance.

Sanitary fill

The experience of San Francisco in handling garbage, rubbish and ashes during the last four years (*ENR* Feb. 27, 1936, p. 314) is said to be illustrative of the possibilities of sanitary-fill where the work is adequately directed and sufficient money is spent for effectively covering the refuse with earth, not only on the top but on the sides as well. By enclosing the material in an earth shell each day, fly and rat nuisances are overcome and fire hazards can be controlled. Drainage from the fill during the rainy season is reported to have an exceedingly disagreeable odor. In this case it is said to be diluted immediately by the waters of the bay, but this item might require special consideration in other places where such dilution is not available. The neighboring city of Berkeley reported that, except for wet garbage, the fill and cover method has been used with satisfaction since 1923. Here the rat nuisance is "abated by poisoning."

Use of ash dumps

Utilization of the mountainous ash and rubbish dump on the Flushing Meadows as a site for the New York World's Fair to be held in 1939 was stated to be the most spectacular recent development in the field of refuse disposal. This accumulation of the refuse from Brooklyn and Queens is now being leveled off and spread over nearly 800 acres of marshland at a rate of more than 40,000 cu. yd. per day. (*ENR* Oct. 22, 1936, p. 565). A kindred activity on a very much smaller scale, carried on rather extensively in many municipalities, is the grading of dumps and their conversion to park areas. This work is of importance as a sanitary measure, and as a means of improving the appearance of cities, particularly of their approaches.

Commenting on a tabulation of per capita costs of sanitation services, released at the end of the year by the Bureau of Census, U. S. Department of Commerce (*The American City*, Dec. 1936, p. 11, and *ENR* Jan. 14, 1937, p. 67), the committee stated that great care should be exercised in comparing the costs in one city with those in others. The wide differences in the character and thoroughness of the services performed, the kinds of materials collected and disposed of, the frequency of collection, the topography and layout of streets, the length of hauls, and the method of disposal, among other items, must be taken into consideration.

The report concluded with a few remarks regarding the status of the sanitary engineer and refuse disposal matters. It was stated that while engineers have had relatively little to do with refuse disposal in the past, it was desirable that they give it their attention, since the material to be handled is an unstable organic substance which may produce offensive conditions if sanitation is not duly considered.

Municipal Reports Improving In Quantity and Quality

CITIES are beginning to see the point of straightforward, clear chronicling of their affairs in the once-a-year report to taxpayers. Clarence E. Ridley, professor of public administration at the University of Chicago, makes this statement after ten years of rating annually the sins of omission and those of commission in municipal reports for the *National Municipal Review*.

Prof. Ridley's rating scale of 100 points was reached within four points of perfection by the 1936 annual reports of Berkeley, Calif., and Cincinnati, O. Bangor, Me., was third, with a score of 95, then Trenton, N. J., with a rating of 93. Charlotte, N. C.; Norfolk, Va., and Two Rivers, Wis., scored 91. Auburn, Me.; Dayton, O.; Louisville, Ky.; and Pasadena, Calif., received ratings of 90. Nine other cities scored between 80 and 89 points which are divided among promptness of publication, certain features of physical make-up, and content. In addition, 43 other cities issued general municipal reports during the year that were "of a high order."

This total of 74 cities issuing reports for 1936 compares with 55 last year and 47 for the year before—"a small number when contrasted with the total number of American cities," Prof. Ridley commented, "but nevertheless a sign of progress toward a wider realization that an informed citizenry is an essential of democratic governmtnt."

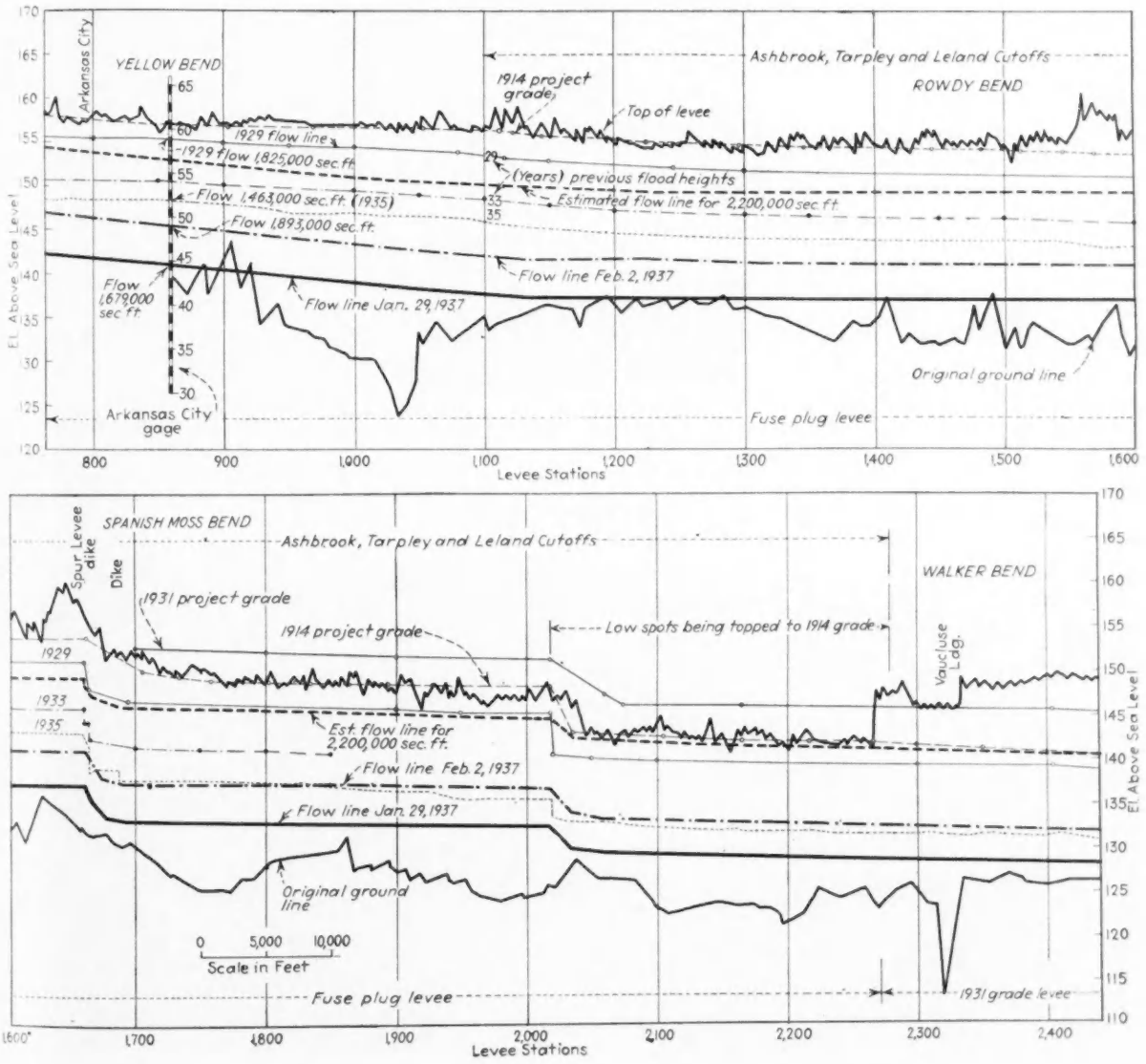
"The decade has seen remarkable changes in the quality, as well as in the quantity of municipal reports," continued Prof. Ridley. "The auditor's report, with minute detail, and the inventory of property and equipment are fast disappearing. No longer is the hurried and harried citizen expected to wade through a hundred pages of meaningless facts and figures. Instead, he is treated to a brief, attractive, readable, interesting account of the activities of his city's government; brief, because the average length has decreased from 90 to 55 pages; attractive, because in physical make-up and illustrative material the modern report compares favorably with the best periodicals; readable, because the reports are not compilations but narratives, well organized, with tables of contents and organization charts; interesting, because they treat of government in terms of activities as well as of expenditures." A recent development is the growing number of cities that are issuing extremely brief reports, lacing in pictures and charts, but just as effectively informative as a bulky report, he adds.

Cutoffs Lower the Flood Crest

Twelve new channels across Mississippi River bends below Arkansas City increases velocity sufficiently to reduce flood heights by several feet at upper end of cutoff area—Vicksburg laboratory model shows flood range

FOR YEARS Mississippi River flood control and hydraulic experts held to the theory that under no circumstance must the river be allowed to shift its course, especially to shorten itself by cutting across the necks of looping bends because the record of the river's history as written in the alluvial plain through which it flows showed that when the river cut off one loop the increased velocity caused it to cut a new loop, thus returning to its original length and slope. For this reason millions of dollars were spent for revetments, dikes and spurs to hold the river in place. In 1929, however, despite all efforts to prevent it, the river cut through Yucatan Bend during the high water stage of that year, and remained in the new channel when the flood receded. Nothing serious happened to the river above or below the cut, and as a result the attitude of alarm toward cutoffs began to change. Extensive studies were begun with models at the Waterways Experiment Station at Vicksburg to determine the desirability of deliberately cutting through several bends, especially in the Greenville area. From the model studies, Gen. Harley B. Ferguson, the new head of the Mississippi River Commission, and others responsi-

PROFILE of west bank levee for 36 miles below Arkansas City. The effect of the Greenville Bends cutoffs in lowering the flood heights is shown by comparison of flowlines on this profile.

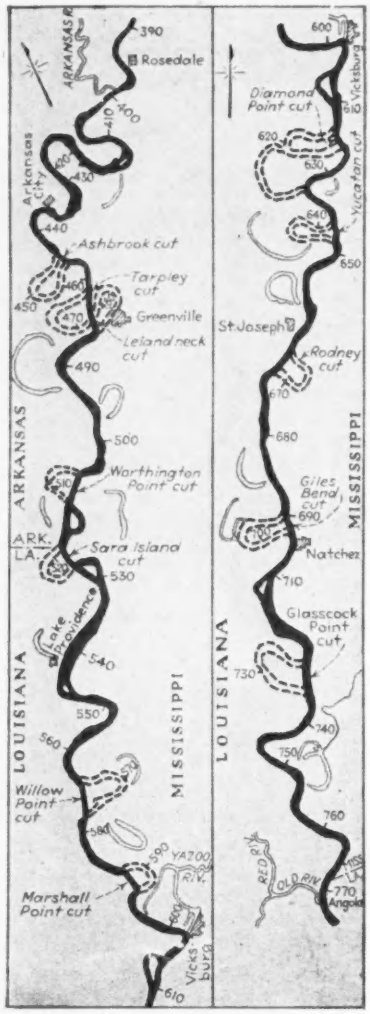


ble for control of the river, became convinced of the desirability of shortening the river (*ENR* June 29, 1933). Since 1931 eleven more cutoffs have been made between Arkansas City, at the mouth of the Arkansas River, and Glasscock Bend, just below Natchez.

The present flood, the first of any great size since the cutoffs were completed and the greatest ever carried down the river without a break in the main levee system, has demonstrated the beneficial effect of the cuts in lowering flood heights. The greatest effect is apparent at Arkansas City, just above the three cutoffs through the Greenville Bends—the Ashbrook, Tarpley and Leland Neck cuts shown in the accompanying map. The accompanying profile of 36 miles of the west bank levee in this area, upon which has been plotted the crest line of previous floods and three flowlines of the present flood, graphically illustrates the reduction in water levels.

The greatest flood ever carried between the levees without a break prior to the present flood was in 1929. A peak flow of 1,825,000 sec.-ft. that year raised the river level to 58.9 on the Arkansas City gage. On Jan. 29, 1937, a flow of 1,679,000 sec.-ft. registered 44.8 on the gage; four days later the flow had increased to 1,893,000 sec.-ft. and the river had risen to 49.0 Thus, when the present flow equalled that of the 1929 volume, the river stage was more than 10 ft. lower. In 1935, before all of the cutoffs were completed, a flow of 1,463,000 sec.-ft. raised the river to 51.0 on the Arkansas City gage.

Predictions made during the last days of January placed the maximum flow of the present flood at Arkansas City as 2,200,000 sec.-ft. This was expected to register 56.4 on the gage, still 2.5 ft. below the 1929 peak height. However, since this prediction was made and the accompanying profiles were plotted, the estimate of maximum flow has been reduced to 2,100,000 sec.-ft., a gage height of 54.5 ft. Therefore, a flow 15 per cent greater than in 1929 will produce a river stage 4.4 ft. lower, all due to the Greenville Bends cutoffs.



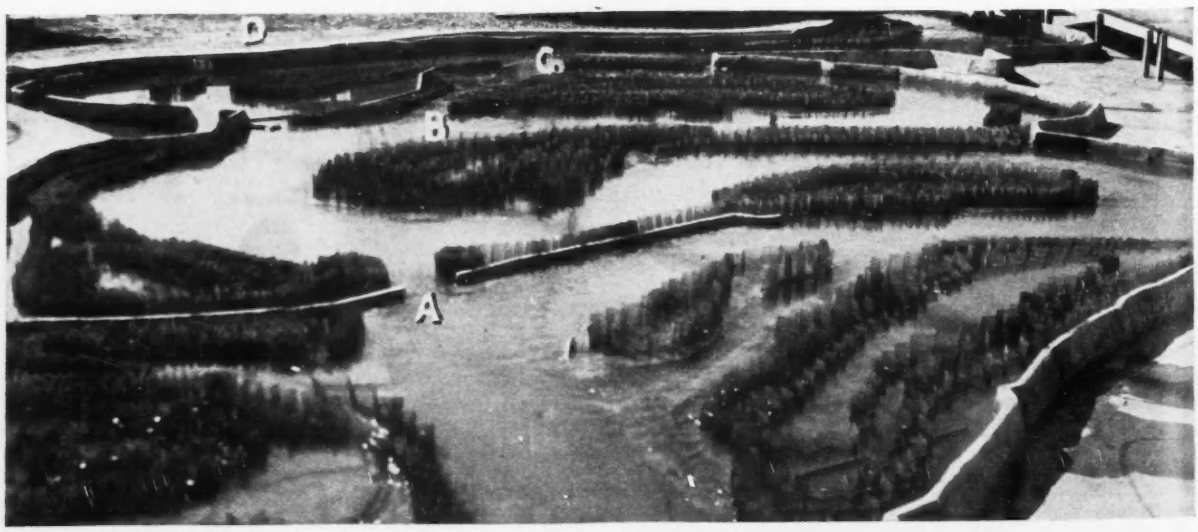
TWELVE CUTOFFS in the Mississippi River since 1929 have changed the course of the stream from Arkansas City.

CUTOFFS AT GREENVILLE BENDS as represented by the large-scale model at the Waterways Experiment Station. (A) Ashbrook Cutoff; (B) Tarpley cut; (C) Leland Neck cut; (D) Greenville.

The effects of the cutoffs in reducing flood heights diminishes somewhat downstream from Arkansas City, but even at Vicksburg, between the seventh and eighth cuts (counting from upstream) the lowering is appreciable. In 1929 the peak flow at Vicksburg was 1,741,000 sec.-ft., and the river registered 55.2 on the Vicksburg gage. On Feb. 4, 1937, the flow had reached 1,752,000 sec.-ft., slightly more than the 1929 peak, and the stage on that date was only 48.2, or exactly 7 ft. lower than for the same flow in 1929. It is conceded that the cutoffs reduce the flood height by at least 6 ft. in the entire lower river.

Levees in good shape

The accompanying profile shows the west side levee for 36 miles below Arkansas City. From Arkansas City to Walker Bend the levee is still at the old 1914 grade and section, for under the Jadwin plan this section was part of the fuseplug for the Boeuf floodway. The Markham plan, which revises the Jadwin plan by substituting the controlled Eudora spillway (not yet built) for the uncontrolled Boeuf floodway, includes raising of the fuseplug levee to a new grade, known as the 1931 grade. This raising has been completed from Walker Bend southward (extreme right end, lower profile). North of Walker Bend the lowering of expected flood crest by the action of the cutoffs has made the levee safe for the present flood except for a few places, mainly in the 3-mile stretch above Vaucluse Landing. These low spots have been raised by dragline and truck methods to well above safe levels. Below Walker Bend the west bank



levee is well above expected flood levels, and the entire east side levee from the Tennessee line south to Vicksburg is all new grade and section. Nothing like the disastrous Mounds Landing crevasse which caused the flooding of Greenville in 1927, is expected to occur in this flood.

Hydraulic laboratory tests

At the Waterways Experiment Station, Vicksburg, a model has been completed of the river from Helena south to Donaldsonville, just above Bonnet Carré. Through this model full-crest flows have been run to show the effects of the cutoffs in reducing flood heights, and the results check closely with predictions and actual flood levels. In addition to the full-crest tests, runs simulating the rise and fall of the flood are made through the model. From these test runs it is possible to visualize the rise of the river, the height to which it will reach on the levees, and the increase in velocity due to the cutoffs.

SPLENDID EXAMPLE of riprapping that has been done under emergency preparation for the coming high waters of tthe present flood. This point is the old dike at Leland Neck, reinforced with stone placed within slat cribs.

Mississippi state officials, worried about possible effects of the flood in relation to the east side levees, went away much assured after viewing the test runs, and were able officially to quiet the fears of Mississippi residents.

Welded Houses for Workers Factory Built and Furnished

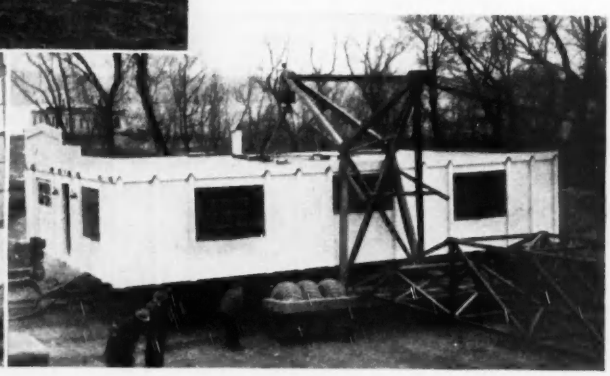
AN INTERESTING advance in house prefabrication is being recorded in the Peoria, Ill. factory of R. G. LeTourneau, Inc., manufacturers of heavy grading equipment, where the first of a large number of five-room houses to be built for company employees has just been completed. Of all-steel, welded construction, the 32x44 ft. units are rigid enough to be moved out of the factory on trailers and watertight enough to be floated across the river to the building site on their own bottoms. The first house is now set up in the company's yard for exhibition purposes. As soon as six houses are completed, they will be towed across the river to their permanent locations.

As a demonstration of possibilities, the first house, shown in the accompanying view, was furnished before it left the factory. The furnace was going and the house was warm as a tractor hooked onto the 16-wheel trailer upon which the 41-ton house rested, and hauled it to the temporary site in the factory yard. Here a tractor crane picked it up by three steel rings attached to the roof and set it on the ground. Within a few hours, water, sewer and electric connections were made, and the house was ready for occupancy. The first house uses asbestos boards for ceilings and living room walls and also utilizes wooden doors, but all future houses will be entirely of steel except for the plumbing fixtures and the rock wool insulation between the walls and between the ceiling and roof.

MOVING to building site.

ROLLING out of the factory.

TRANSFERRING to foundation.



Assembly procedure

In constructing these houses the floor is built upside down and in two sections, each of two ¼-in. plates 8 ft. wide by 44 ft. long tacked together. These plates are laid on a concrete and steel platform of the exact ground area of the house, 32x44 ft., and on top of them 6 in. I-beams are set crosswise at 2 ft. intervals and welded. Then 12 in. channels are placed along the outside edges and welded to the plates.

Two girders, each consisting of two I-beams welded together, run the length of the floor. After water and soil pipes are installed, the whole underside is painted with a primer coat covered by a coat of black asphalt paint. The two halves, tacked together, are then turned over and weld beads laid down the 44 ft. length of the three joints between the four plates, making the floor structure a solid unit. This then is given a primer coat of paint as is every other metal surface in the house whether exposed or concealed.

The floor structure completed, it is lifted off the platform making way for the roof which is built rightside up. First the ceiling plates of 10-ga. steel, 48-in. wide and 22 ft. long, are laid and tacked together. To these plates 6-in. I-beams and 12-in. channels are welded as in the case of the floor. The ducts for the heating and cooling system are installed, and as the 10-ga. roof plates are laid on, rock wool is blown into the 6-in. space between the roof and ceiling. The 4 in. space between the two steel plates forming the exterior and interior walls is also filled with rock wool. About 4 tons of this insulation is used in each house.

In the meantime the walls have been under construction on another jig. Sheets of 10-ga. plate, 48 in. by 96 in., are used, being bent to form a box-type rigid section. These sections are so fitted together that the longest distance between braces is 21½ in. Plates are cut and fitted to form window or door openings, around which Z bars are welded to form the sash. Conduits for wires are built in as the wall construction progresses.

When the wall sections are completed they are set up in place on the floor structure and welded to it. Then the roof is laid on and welded into place. When plumbing and lighting fixtures and outlets and heating and cooling plant have been installed, (the latter in the combination garage, laundry and recreation room) the house is decorated inside and out, jacked up and mounted on a trailer and moved out of the factory. The all-steel house was proposed by R. G. Le Tourneau and designed by Ephraim Field.

Simplified Computations For Two-Way Slabs

Tables and diagrams developed to apply design method given in new A.C.I. building code

LAST YEAR at the Chicago convention the American Concrete Institute gave tentative approval to a new set of building regulations for reinforced concrete prepared by its standard building code committee. One of the most important innovations was an entirely new section relating to the design of two-way slabs supported on four sides and applicable to any combination of irregular panels. Some criticism of the manner in which this design procedure was presented prompted the committee to make a restatement in more simplified form, with no change however in substance, and this new version will be presented to the convention next week when the regulations come up for final adoption.

The essentials of the simplified method follow and its simplicity of application is made evident by an example set up in tabular form. The development of the basic formulas used was described by J. Di Stasio and M. P. Van Buren in the January-February, 1936, *Journal* of the American Concrete Institute and the formulas themselves also occur in the A.C.I. code, section 709 of Chapter 7. The presentation below, developed by Mr. Di Stasio, covers only the bare mechanics of the method; in other words, what the designer needs to know.

NOTATION

A — Span length in one direction
B — Span at right angles to A
$F_A A$ — Distance between lines of inflection in span A considering span A only to be loaded
$F_B B$ — The distance between lines of inflection in span B considering span B only to be loaded
N — Sum of the lengths of those edges of panel AB which are also edges of adjacent panels continuous with AB
w — Uniformly distributed load per unit area
t_s — Minimum permissible slab thickness
r_A — Proportion of total load carried by span A
r_B — Proportion of total load carried by span B
c_A — Factor modifying r_A used in obtaining an equivalent uniform load for bending moments on span A
c_B — Factor modifying r_B used in obtaining an equivalent uniform load for bending moments on span B
K_A — Stiffness factor I/A for span A
K_B — Stiffness factor I/B for span B
K_{AR} — Stiffness factor for any span adjacent to and continuous with span A
K_{BR} — Stiffness factor for any span adjacent to and continuous with span B
x — Distance from face of support to point in span

In the first place it is required that the slab thickness satisfy the prescribed working stresses and is not less than 4 in. nor less than $t_s = \dfrac{A + B - 0.1N}{72}$

The next step is to determine the coefficients F_A and F_B and these are given in the accompanying table for various stiffness ratios. In obtaining these values the stiffness ratio of span A is K_A and of the adjacent span is K_{AR}. For interior spans where the adjacent spans are different, it is proper to use the average of the value of F_A given by K_A/K_{AR} to the right of span A and of F_A for K_A/K_{AR} to left of span A. Values for F_B are obtained by replacing K_A/K_{AR} by K_B/K_{BR}.

VALUES OF F_A AND F_B

Span A	$\frac{K_A}{K_{AR}}$	0.00	0.25	0.50	0.67	0.80	1.00	1.25	1.50	2.00	4.00	.00
Interior	F_A	0.58	0.65	0.69	0.72	0.74	0.76	0.78	0.80	0.83	0.89	1.00
End	F_A	0.75	0.80	0.83	0.84	0.85	0.87	0.88	0.89	0.91	0.93	1.00

Notes:

For simple spans, $F_A = 1.00$.

For values of K_A/K_{AR} between 2/3 and 3/2 the value of F_A may be taken as 0.76 for interior spans and 0.87 for end spans.

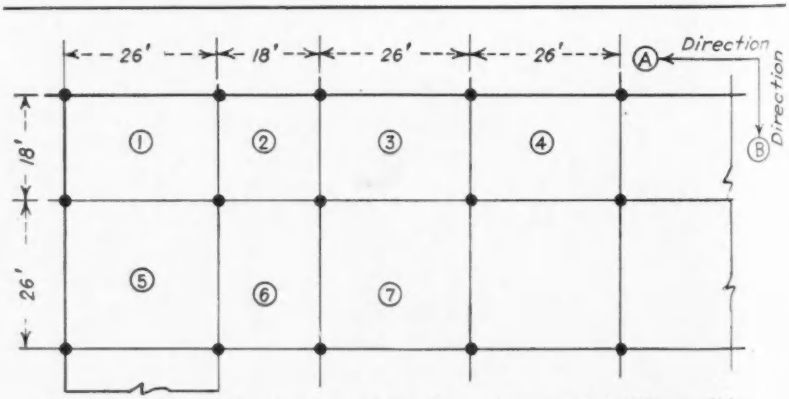


FIG. 1—LAYOUT of various size slabs that represents a typical building condition.

Bending moments

The bending moment at any section is determined with the same coefficients prescribed for one-way construction but using the following equivalent uniform loads per unit length of span considered:

Slab, strip of unit width, span A . . . . . $(e_A r_A)\, w$

Beam, span A, per half panel tributary width $(B/2)$: $B/2$ $(1—e_A r_A)\, w$

Shears

The shear at any section x distant from the face of the support is taken as follows:

Slab, strip of unit width, span A

$$\left(\frac{A}{2} - x\right)\left[r_A - \frac{6\, r_A}{A}(1 - e_A)\, x\right] w$$

Beam, span A, per half panel tributary width $(B/2)$ . . .

$$\frac{B}{2}\left(\frac{A}{2} \quad x\right)\left[1 - r_A + \frac{6\, r_A}{A}\,(1—e_A)\, x\right] w$$

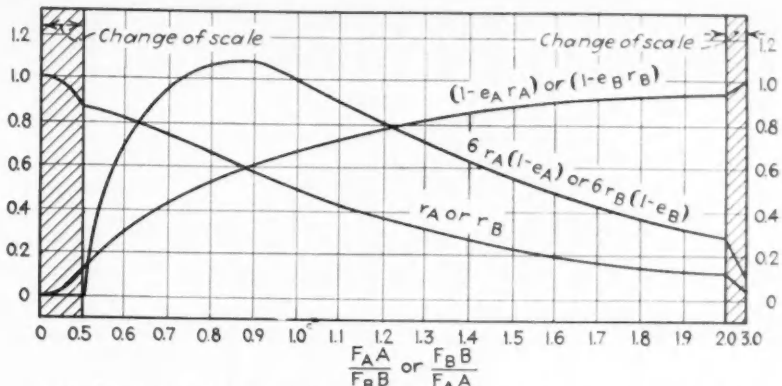


FIG. 2—GRAPH of values of factors required in determining moments and shears in two-way slabs.

For slabs and beams spanning in the B direction, the above expressions for both moments and shears are altered by replacing A with B, B with A, r_A with r_B and e_A with e_B. Also when either or both ends of span A is not rigidly attached to the supports, the value of e_A in that direction is taken as 1.0. The factors required in the above expressions can be obtained from the graphs of Fig. 2. Their values and the values of bending moments and shears for panels of dimensions shown in Fig. 1 are given in terms of the unit load in the tabulation.

DESIGN PROCEDURE FOR MOMENTS AND SHEARS

FACTORS				Bending (see Fig. 2) Equivalent Uniform load[2]				SHEARS			EXAMPLE				
Panel	[See table]			Slab ↓	Beam		↓	Beam	End reaction	Shear at any pt X from support [4]	Shear at face of support	Shear at ⅛ pt from support [5] →	Shear at ¼ pt from support →		Shear at mid point
A Direction	$\frac{K_A}{K_{AR}}$	F_A	$\frac{F_A A}{F_B B}$[1]	$E_A r_A w$	$(1-E_A r_A)$	$\frac{B}{2}$	$\times w$	$\left(\frac{B}{2}\times\frac{A}{2}\right)$	$(1-r_A)\times w$	$(0.5-\frac{X}{A})\left[6 r_A(1-e_A)\frac{X}{A}+(1-r_A)\right]\frac{AB}{2} w$	$\frac{X}{A}=0$ Gives end reaction	$\frac{X}{A}=0.125$		$\frac{X}{A}=0.25$		$\frac{X}{A}=0.5$
1	0.69	0.84	=1.36	0.18w	0.82	9	7.4w	117[3]	0.72 84w	$(0.5-\frac{X}{26})\left[0.66\times\frac{X}{A}+0.72\right]\times 234w$	0.5X0.72X234 = 84w	0.375(0.08+0.72)x234=70w		0.25(0.16+0.72x234= 51w		0
2	1.45 1.45	0.80 0.80	0.80 =0.90	0.40w	0.60	9	5.4w	81	0.42 34w	$(0.5-\frac{X}{18})\left[1.08\times\frac{X}{A}+0.42\right]\times 162w$	0.5X0.42X162 = 34w	0.375(0.13+0.42)x162=33w		0.25(0.27+0.42)x162+ 28w		0
3	0.69 1.0	0.72 0.76	0.74 =1.21	0.23w	0.77	9	6.9w	117	0.64 75w	$(0.5-\frac{X}{26})\left[0.81\times\frac{X}{A}+0.64\right]\times 234w$	0.5X0.64X234 = 75w	0.375(0.10+0.64)x234=65w		0.25(0.20+0.64)x234+ 61w		0
B Direction	$\frac{K_B}{K_{BR}}$	F_B	$\frac{F_B B}{F_A A}$	$E_B r_B w$	$(1-E_B r_B)$	$\frac{A}{2}$	$\times w$	$\left(\frac{A}{2}\times\frac{B}{2}\right)$	$(1-r_B)\times w$	$(0.5-\frac{X}{B})\left[6 r_B(1-e_B)\frac{X}{B}+(1-r_B)\right]\frac{AB}{2} w$	$\frac{X}{B}=0$	$\frac{X}{B}=0.125$		$\frac{X}{B}=0.25$		$\frac{X}{B}=0.5$
1	1.45	0.89	=0.73	0.55w	0.45	13	5.8w	117	0.28 33w	$(0.5-\frac{X}{16})\left[1.01\times\frac{X}{B}+0.28\right]\times 234w$	0.5x0.28x234 = 33w	0.375(0.12+0.28)x234=34w		0.25(0.25+0.28)x234+ 31w		0
2	1.45	0.89	=1.11	0.28w	0.72	9	6.5w	81	0.58 47w	$(0.5-\frac{X}{18})\left[0.89\times\frac{X}{B}+0.58\right]\times 162w$	81-34 = 47w	0.375(0.11+0.58)x162=42w		0.25(0.22+0.58)x162+ 32w		0
3	1.45	0.89	=0.83	0.45w	0.55	13	7.1w	117	0.36 42w	$(0.5-\frac{X}{18})\left[1.07\times\frac{X}{B}+0.36\right]\times 234w$	117-75 = 42w	0.375(0.13+0.36)x234=43w		0.25(0.27+0.36)x234+ 37w		0

Notes: 1- *Only necessary to compute A direction, as B quantities are reciprocals*

2- *Only necessary to obtain $e_A r_A$ since bending moments of the slab + beam = 100 per cent of the load on slab*

3- *¼ panel load = 117 w. End reactions in A and B directions at column = ¼ panel load. Only necessary to compute A direction, as ¼ panel load - A reaction = B reaction thus: 117w - 84w = 33w*

4- *In practice it is usually advisable to obtain shear at say, ⅛ or ¼ pts. Therefore, formula may be written with $\frac{X}{A}$ as variable ratio. Then, simple substition where X=0 gives end reactions*

5- *Due to effect of torsion and corner moment, beam formula gives shears higher near regions of support than that obtained by purely uniform load distribution. This is in line with results obtained thus far from Lehigh University tests now in progress*

Pennsylvania Railroad Plans Extensive Electrification of Its Lines

The Pennsylvania Railroad has announced its intention of continuing the electrification of its freight and passenger lines between Philadelphia and Harrisburg, Pa. This will mark the completion of the original electrification program on the eastern lines as announced by executives of the Pennsylvania Railroad early in the winter of 1928.

The new work will involve electrification of 315 mi. of line and 773 mi. of track. On the completion of the work, the Pennsylvania Railroad system will have 2,677 miles of electrified trackage. The construction work for the new electrification will be of the same type as that now employed elsewhere in the railroad's eastern electrified territory. It is known as the cross-catenary construction, based on a system of overhead conductors held in place by an arrangement of flexible wires supported between structural steel poles set in concrete beds beyond the outer edges of the track.

The four-track main line of the Pennsylvania is now electrified between New York, Trenton, Philadelphia, Wilmington, Baltimore and Washington, as are also the commutation lines around Philadelphia and New York. The chief lines now to be electrified are: the main line from Paoli, just west of Philadelphia, to Harrisburg; the freight line from Morrisville, Pa., near Trenton, N. J., to Harrisburg; the freight line from Columbia, Pa., to Perryville, Md.; and the freight line from Monmouth Junction to South Amboy, N. J.

The work will be financed by a $52,670,700 bond issue.

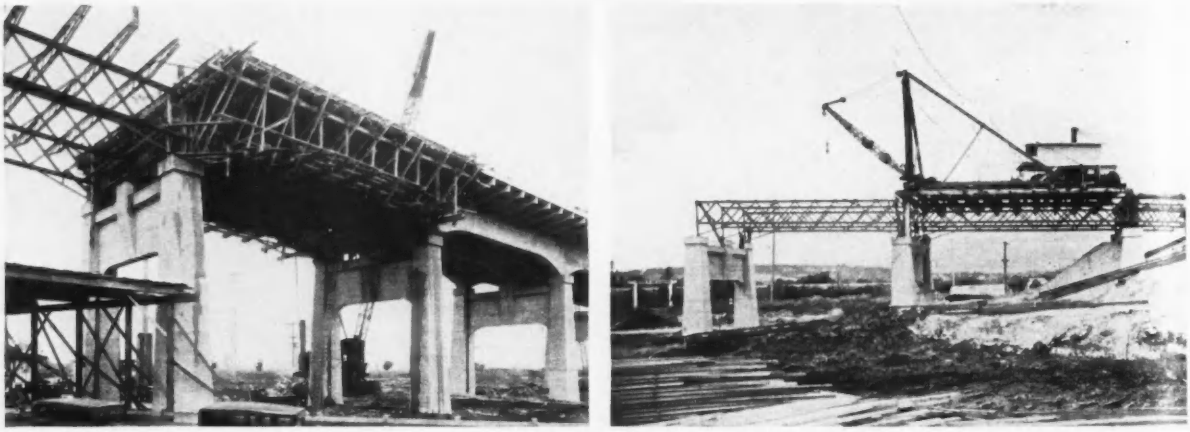


FIG. 1—FORMS WITHOUT FALSE WORK on the high approach to Fraser River Bridge (left) which are hung from structural reinforcing erected by derrick traveler.

Self-Supporting Reinforcing In Concrete Bridge Girders

Height of approach to Fraser River Bridge would have made falsework expensive—Steel carries weight of forms and fresh concrete

THE HIGHWAY BRIDGE now being built across the Fraser River at New Westminster, B.C., to replace the old structure on this main artery for automobile travel between Seattle and Vancouver, has a 1,400-ft. approach on its south end. Soft bottom and a floor height of 90 ft. at the river end of the approach would have made falsework expensive, so light steel trusses were set in each span to serve a dual purpose. During construction they support the dead weight of concrete and forms, and after the concrete has set they fulfill their more permanent function as reinforcing within the concrete girders. This type of construction was used for twenty spans; eleven of 73 ft. 8 in., one of 104 ft. and eight of 58 ft. 8 in., all of which have three parallel girders per span.

FIG. 2—REINFORCING STEEL ASSEMBLY on the Fraser River Bridge ready to carry the timber forms.

When the concrete substructure was ready, steel erection was begun at the shore end by a traveling derrick which first set the three steel trusses in each bent, placed upon them the transverse beams which support the floor system and then moved out over the steel just placed, repeating the operation in the next span. The trusses were made up with chords of two heavy angles and webs of angles and flats. In some cases additional round bars were welded to the bottom chords to provide the required area under live load.

Forms hung from reinforcing

After the steelwork was in place, wood forms for the concrete girders were assembled in the usual way except that instead of being supported on falsework the forms were suspended from the steel trusses. Because all the steel was welded together in units as an advance operation, the reinforcing was already spaced accurately before the forms were placed, thus saving a considerable amount of time as compared to usual methods of reinforced concrete construction.

Each steel truss was fabricated with a camber sufficient to allow for the expected deflection under the load it would carry while the concrete was setting. Thus, when the concrete had hardened the finished surface of the concrete girders was at the desired grade. Prestressing of the steel caused by this method of construction does not prevent it from functioning effectively in carrying the loads ordinarily imposed upon reinforcing in a concrete girder.

The bridge was designed for C.E.S.A. loading U-100 with a 20-ton truck in each of the four lanes. The original design provided for two concrete girders under the 40-ft. roadway. However, to adapt the design to the most effective application of the self-supporting reinforcing, a third girder was added. Section and elevation of the girders are

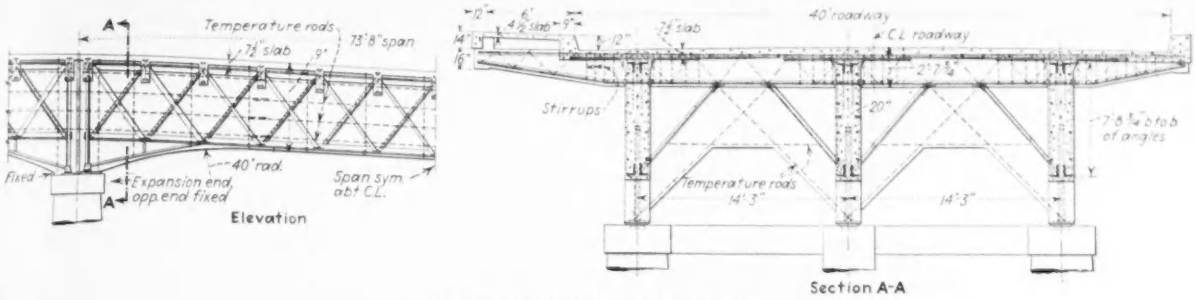


FIG. 3—SECTION AND ELEVATION of the self-supporting reinforcing in a typical span of the south approach.

shown in the accompanying drawing. The cost of this construction on the long approach, including foundations, supporting columns, lighting, etc., amounted to about $230 per lin.ft. of the approach structure.

This method of making the reinforcing steel function in two ways was developed by C. S. Kane, of the Dominion Bridge Co., Ltd., contractors for the Fraser River Bridge. The structure is being built for the British Columbia department of public works. W. G. Swan, consulting engineer, Vancouver, is consultant on the project.

Dynamiting Old Timber Trusses Adjacent to New Concrete Span

THIRTY CHARGES of 60 per cent dynamite inserted in the members of a 140-ft. span timber truss bridge at Estacada, Ore. served recently to drop a 112 ft. length of the structure into the Clackamas River without damage to a new concrete span immediately upstream; clearance between the two structures at the closest point was only 8 in. The method, which was adopted because of the difficulty and expense of supplying falsework supports, proved to be economical and time saving.

The alignments of the old and new bridges diverge, but at the south end the structures practically touched. To add to the complications, the foundation rock which supported the south abutment of the old bridge was in the form of a shelf that was so faulty and unstable as to require extensive excavation and reinforcement before the new concrete arch abutments could be built. It was particularly desirable that the falling timbers should clear this shelf. The object was to drop the trusses straight down.

The first operation consisted in the removal of the decking, the roof and the stringers. To guard against sidewise movement, struts were placed between the new and old bridges for some distance out from the south end. Temporary shoring was also placed under the panel points just ahead of the abutments. Cable tie-backs were used to brace the end panels of the bridge which were over the river bank and were not to be dropped.

The members of the truss were of laminated type made up of three timbers each. The battery had a capacity of only 30 fuses while for maximum effectiveness, 38 charges should have been used, placed in double rows of threes as shown in Fig. 2. In place of the extra 8 charges therefore, the outside timbers of the members were cut through at seven points; at the eighth point, however, the proximity of a high tension line did not permit the cut to be made, and no provision was made for weakening this timber.

When the charge was set off, the structure did not fall exactly as planned but instead the upstream truss broke at about midstream. This is believed to have been due to a lag in the fall caused by the slow breaking of the truss member near the high tension line which could not be severed. However, the procedure was in the main successful.

The work was done by the Mountain States Construction Co., Frederic Lindsay, president. L. C. Smitton represented the Oregon state highway department on the job.

FIG. 1—Location of dynamite charges in timber truss. Dots on truss outline indicate placement of 30 shots disposed in each member as shown in the sketch.

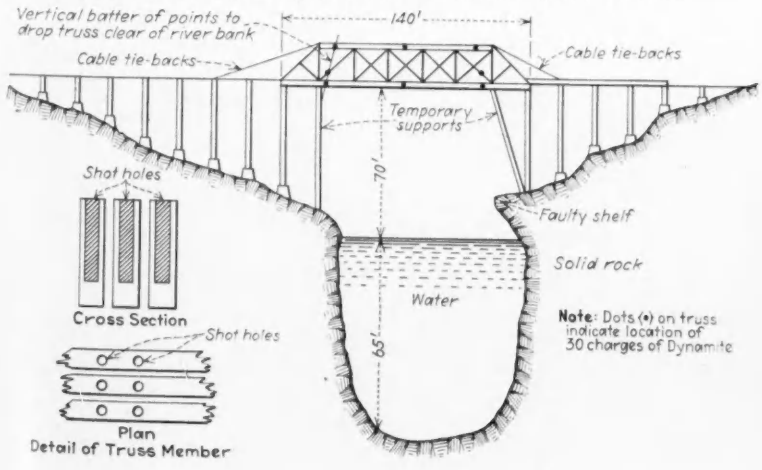


FIG. 2.—Dropping an old timber truss bridge by exploding charges of dynamite inserted in the members.

CURRENT NOTES ON SEWAGE DISPOSAL

An analytical summary of recent developments conducted by

WILLEM RUDOLFS
Chief N. J. Sewage Experiment Station
New Brunswick, N. J.

● TREATING A STREAM

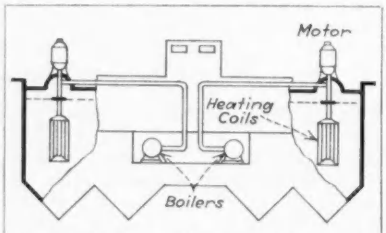
For several years the entire flow of the river Emscher in Germany has been treated by passing it through large mechanically cleaned clarifiers. This precedent set an example for Stuttgart where recently it was decided to treat a small stream used for conveying large volumes of leather, steel and chemical industrial wastes. The amount of sludge from these wastes was at least equal to that of the domestic sewage from Stuttgart. Maier and Sohler (*Gesundheits-Ingenieur,* Nov. 28, 1936) describe the method used and the precautions necessary to prevent the cold brook water from affecting adversely the temperature of the sludge during the winter months. A part of the stream was converted into a long, narrow, flatbottom settling tank with sludge hoppers at the end, and provided with a sludge removal mechanism. The tank with two inlets, one for the summer flow and the other for the winter flow, takes care of velocity changes and provides dispersion of the sewage through a number of parallel inlet channels of uneven length. The velocity through the tank amounts to 8.5 ft. per. min.; sludge production is 5,250 cu.ft. per day with a moisture content of 93.7 per cent.

● ACTIVATED SLUDGE pH

Sanitary chemists and sewage plant operators have frequently discussed the possibility of an optimum pH for oxidation of sewage, particularly in connection with the activated sludge process. Some believed that a slightly acid medium of about 6.5 was best, and attempts were made to control the pH value near this point by the introduction of acidic materials or acids. Others claimed that their observations and results led them to believe that the sewage was best oxidized or that activated sludge-sewage mixtures were most effective when the mass was slightly alkaline. The optimum for different places varied from pH 7.4 to 8.2. Laboratory experiments made by Wooldridge and Stanfast (*Biochemical Jour.* 30, 156–162, 1936) on the effect of pH on the oxidation of sewage and sludge indicate that sewage undergoes oxidation readily between the range of 6.0 and 9.0. Their experiments were carefully controlled, proper buffers were added to maintain definite pH values, and the materials were kept at constant temperatures. The investigators conclude that there may be a possible optimum pH of 7.3. When the sewage mixtures became very acid (pH 5.0) or very alkaline (pH 10.0) oxidation still continued but at a slower rate; at pH 4.0 oxidation was completely inhibited. The effect of pH on the oxidation of sewage in the presence of activated sludge is the same as for sewage alone. They conclude that "for efficient working of an activated sludge plant the pH of the system should preferably be kept between 6.0 and 9.0."

● SLUDGE HEATING

The generally accepted method of heating separate digestion tanks is by circulating hot water through coils in the digestion tanks. Heat exchangers for raising the temperature of fresh solids prior to their addition to digestion tanks, and the introduction of steam and hot water into tanks have also been used with some success.



ROTARY heating coil units installed in Stuttgart digestion tanks.

The drawbacks of circulating hot water through stationary coils are principally the possibility of incrustation and the difficulty of positioning the coils in the most active zone of digestion; this zone varies with the quantity of ripe sludge present. Good heat exchangers are rather costly and poor ones are apt to produce odor. Introduction of steam or hot water directly into the tank may cause localized overheating and the production of increased quantities of supernatant liquor. To overcome some of these difficulties Maier and Sohler (*Gesundheits-Ingenieur,* Dec. 5, 1936) describe a heating device consisting of four separate bundles of pipes suspended into the tank. These heating units can be separately rotated and lifted out for cleaning or repair without placing the entire heating system out of operation (see sketch). The cooled water is returned separately from each unit. The device has been installed in two new large digestion tanks at Stuttgart, Germany.

● VENTILATED TRICKLING FILTERS

Some years ago Stroganoff at Moscow reported that air drawn through trickling filters allowed much greater rates of sewage application than was possible in filters without air. On the basis of a pilot plant constructed at Soest, Westphalia, Prüss and Blunk claimed that covered trickling filters equipped with means to apply an upward air stream through the interstices allowed the rate of application to be increased from five to seven times the normal rate. The theory was that in ordinary trickling filter operation the quantity of air introduced was insufficient for rapid and complete oxidation and that the carbon dioxide concentration in the lower part of the bed was toxic to the oxidizing bacteria. Groote (*De Ingenieur,* No. 11, 1936) who built two experimental trickling filters at Hilversum, one of which was covered and supplied with aeration devices and another uncovered and without air, both receiving the same sewage, concludes that the results have not shown any material advantage for ventilated covered beds. Kessener, in discussing the methods, stated that the additional cost with air was in no way commensurate with the improvement in results.

● AERATION SYSTEM EFFICIENCY

There are very few large-scale experiments where different types of activated sludge aeration systems have been compared. Conclusions have generally been drawn from results obtained at different plants where varying types of sewage were treated. The results obtained at Manchester (England) during one year's operation of a 17.67 m.g.d. direct aeration (diffused air), a .66 m.g.d. bio-aeration (paddle wheel), and a 1.22 m.g.d. Simplex plant are of great practical interest. Here the same settled sewage is being treated to as near the same degree as possible in an effort to compare cost.

The most exacting test of any system of sewage purification is the production and maintenance of effluents of satisfactory quality during periods when sewage strength is at a maximum. This is especially true when large quantities of trade wastes are present. The published results (Rivers Dept. *Annual Report* 1935–36) are extensive and the following summary shows in part the average yearly figures obtained. The raw and the

settled sewage contained suspended solids of 234 and 137 p.p.m. and a B.O.D. of 208 and 169 p.p.m. respectively.

	Direct Aeration	Bio-Aeration	Simplex
Suspended Solids.....	26	29	27
B.O.D.	17	23	20
Hours Detention.....	9.2	16.8	13.1
Horsepower per m.g.	30.05	41.3	24.5
Purification, per cent*	90.0	86.4	87.9

*Calculated on B.O.D. of settled sewage.

The bio-aeration plant results were less uniform than from the other plants; the direct aeration system yielded effluents of superior quality with considerable less detention than the mechanical plants. The power required for the Simplex plant averaged 5.5 hp. less per million gallons treated than the direct air units. It is of interest to note that during a short period in summer the presence of abnormal quantities of tar oils in the sewage caused serious deterioration of the effluents from the mechanical plants and had but little effect on the direct air system.

The relative annual charges on capital outlay and estimated cost of renewals over a period of years are now being studied to make a precise comparison of the Simplex and direct aeration systems. The bio-aeration system is evidently considered as unsuitable under the conditions. It should be kept in mind, however, that the length of channels used in this system at Manchester were greater than those found to be best at Sheffield and elsewhere.

● HOW POLLUTION AFFECTS FISH

It is a well established fact that sewage, chemical salts, poisons such as arsenic and hydrocyanic acid, mine and cannery wastes cause the death of fish when large quantities of these materials are suddenly discharged into streams. There has been question, however, whether small quantities discharged regularly may affect fish life. Ellis (*Culturist*, July, 1936) comes to the conclusion that the detrimental actions of any given effluent are functions of the dilutions in which the effluent reaches the fish. High dilutions which may seem to be harmless over short periods may produce disastrous results through cumulative action. Experimental work done in fish ponds in Germany and results obtained in Scandinavia indicate that no cumulative effects are noticeable and that the harmful results vary with several factors including the type of fish.

● GREASE FROM SLUDGE

From time to time the question of recovery of by-products from sewage sludge comes to the foreground. Extraction of grease has been practiced at a number of places, but eventually discarded unless excessive quantities were present. Estimates show that for a population of 100,000 people from 180 to 365 tons of crude fats are present in the sludge. After a study to compare the utilization of crude fats by extraction with the production of gases by digestion, Sierp (*Gesundheits Ingenieur*, Aug. 28, 1936) concluded that if an extraction process is employed fresh solids only must be used. Gas production for power and heat is considered simpler, more economical and, from a technical standpoint, better practice.

Steam Heating Plant Warms Concrete Aggregate

CONCRETE tunnel lining in the Mono Craters tunnel, under construction by the City of Los Angeles at an elevation of nearly 8,000 ft., is being carried on during the winter months when temperatures outside the tunnel sometimes get as low as 20 deg. below zero. Within the tunnel it is easy to maintain temperatures suitable for concrete placing and hence cold weather precautionary measures are required only at the mixing plant and in adjoining stockpiles near the tunnel portal.

The simplest method of heating the materials was to install a steam heating system over the gates through which the aggregate moves by gravity from stockpiles into the tunnel where cars that serve the mixer are loaded. The heating equipment was put in prior to dumping material in the stockpile and was arranged as shown in the accompanying illustrations.

Two 40-hp. steam boilers were set up near the end of the stockpile tunnel. A pipe line from the boilers delivers steam to a circulating system which includes a pair of drums at each aggregate gate. Circulating pumps are used in the return line. By this arrangement temperatures in the vicinity of each gate are kept high enough so that surrounding materials are thoroughly warmed for a distance of several feet. The expense of installation was low and in large measure the structures over the gates were built up with material from the city's storage yard, put together with a welding torch.

A steam pipe also is run to the batching plant and will be used there to heat materials in the weighing bunkers should that be necessary to maintaining a temperature of 60 deg. in the mixed concrete.

FIG. 1—THE HEATING SYSTEM consists of two vertical boilers (left foreground) supplying the circulating system through heating units over each gate.

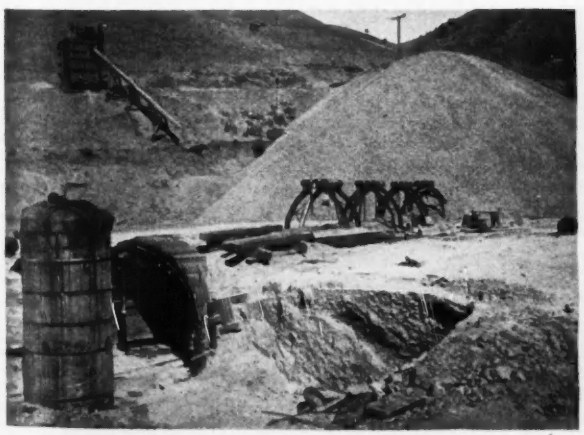


FIG. 2—OVER EACH GATE a pair of drums is supported in such a position that radiation will heat the aggregate near the gate opening.

Letters to the Editor

Shortage of Engineers

Sir—Is it a fact? If so, what is the answer?

I hear from various sources: "We can not get competent engineers".

From my own personal acquaintance, I know of at least four competent engineers and specialtists in their branches of structural and civil engineering, who would be only too glad to find a position anywhere as good as the one they held previous to 1930 and 1931.

One man who knows his work thoroughly and who has been in charge of a large structural drafting room, employing from 100 to 150 men, and a very capable draftsman as well as designer himself, after some negotiation was offered $1.00 an hour on complicated steel work. He turned this down, and the personnel man hired some one willing to accept that figure, and as a result will probably pay twice as much, if not more, in time lost and errors corrected, if they are corrected.

Another acquaintance accepted a job with a promise of at least two months' work. After working night and day for two weeks in order to get the plans out on schedule time, he was told that he was through. He had previously left a temporary job at better salary to accept this job. Going back to his former company, who were expecting to start work on a large contract very shortly, he told the personnel director that he had another position in prospect in another city, but would prefer to stay in his present location if they had work for him, was advised that they would start work in a week or so. He waited until two months had passed being continually told that they would start in a week or so. In the meantime he lost the opportunity of the other job and used up all of his savings.

Another was offered a position with a large railroad company at $150 a month for three or four months' work and was told that that was the top price they could pay and that he was only being offered that much because he was a personal friend of the chief engineer.

Another was offered a temporary job at $45 a week requiring a knowledge of rather intricate steel design and a professional engineer's license.

One man who had specialized in suspension bridge work and had worked on special studies and computations with several papers on the subject was hired at a small salary by a large steel company and then was turned loose as soon as he completed his study for them.

All of these men are first class in their line, with thorough technical training, broad practical experience, excellent records and members of the American Society of Civil Engineers.

The jobs are temporary which means that the actual salary earned is equivalent to about half of the amount stated due to loss of time looking for other work.

In my opinion, Mr. Roberts should retract his last paragraph as the public will always find the engineers of the U. S. C. & G. S. alert to their responsibilities.

W. W. STUDDERT

Denison, Texas
Feb. 2, 1937

Determining Beam Deflections

Sir—In the article, ENR, Dec. 10, 1936, p. 828) the author's method of solution gives correct results, but for such an illustrative example as shown in Fig. 3 of the author's paper it seems there is another method known as "The Shear Area Method" (See *Transactions* Am. Soc. C. E. Vol. 101, 1936 p. 951 equation (30) and page 950 equation (23), also equation (26) p. 950) which the writer believes requires less time for calculating the deflection than by using the author's method.

For the solution of deflections by "The Shear Area Method" given quantities are substituted in general simple algebraic equations from which the desired results are obtained.

The solution of deflections by "The Shear Area Method" is simple and will also solve the conditions when the moment of inertia changes along the length of the span, and all can be done by solving simple algebraic equations.

A. W. FISCHER
Veterans Administration

Washington, D. C.
Feb. 4, 1937

Elevations on Bench Marks

Sir:—With reference to the letter from K. T. Roberts of Yuma, Ariz., in which he complains concerning the fact that elevations are not found stamped and Coast and Geodetic Survey bench-mark disks:

The particular mark referred to in Mr. Robert's letter happens to be a mark established by the U. S. General Land Office, but the same criticism might apply to the bench marks established by this bureau in the majority of the cases.

The field procedure followed by the Coast and Geodetic Survey in running its control leveling will not permit of the stamping of the elevations on the bench marks at the time the leveling is actually run. The leveling is done with metric rods and even the field elevations in meters are not known until after the party returns to the field office and makes the field computations. The records are then sent to Washington where the various corrections for temperature, length of rod, index error, and lack of adjustment of the instrument are applied.

After the final office computations are made, these lines must be adjusted to the control net and it is only then that the final elevations become available in meters and can be converted to feet for use in stamping the bench marks.

During the past two or three years, many thousands of elevations have been stamped on Coast and Geodetic Survey bench marks and it is our practice to stamp the elevations on the disks as rapidly as they become available for use and when funds are available for placing parties in the field for this purpose.

If, when anyone finds one of our bench marks without the elevation stamped on it, he will forward to this office a statement concerning the location in which the mark has been found and a statement concerning the lettering and numbering found to have been stamped with dies on the disk, this office will furnish him with the best available elevation for the mark.

J. H. HAWLEY
Acting Director,
U. S. Coast and Geodetic Survey.

Washington, D. C.
Jan. 22, 1937.

Sir: Mr. Roberts in your *Letters to the Editor* column expresses some dissatisfaction with the methods of the U. S. Coast and Geodetic Survey. If he had anticipated his wants only for a few days and had gone to the trouble to write to the Director of the Coast and Geodetic, he would have received any available information very promptly.

I have had occasion to ask the Survey for information regarding triangulation stations and bench marks in this vicinity. As a result I now have information on precise leveling from Oakland to Sacramento and Fresno, Calif. Also geographic positions and plane coordinates for triangulation stations covering the whole state of California.

For prompt and courteous cooperation in engineering work I think that the U. S. Coast and Geodetic Survey is excellent.

H. G. McDOWELL

Antioch, Calif.
Feb. 4, 1937

Sir—For several years I was employed by the U. S. Coast and Geodetic Survey and came to admire the efficiency, wisdom and honesty of that organization. Through my service I came to know the problems of levelling and bench marks as only those who are in constant contact with precise surveys may. It is not my duty to caution K. T. Roberts (*ENR*, Jan. 28, p. 139) about rash criticisms, but I feel that the engineers of the country should profit by his experience.

Regarding his first paragraph, I believe that any surveyor or engineer

contemplating work in any given area would be wise to make contact with the U. S. Coast and Geodetic Survey, the U. S. Geological Survey, the U. S. Engineers and the local control surveys of the various states. Without such advance information as he can obtain from these sources he would be going out unequipped almost as much as being without the proper instruments.

Regarding, paragraph two, the symbols found on marks are easily identified by writing or wiring the U. S. C. & G. S.

The elevations are not to be stamped on the mark at the time of levelling, as the levels must be adjusted. The U. S. C. & G. S. makes the practice of stamping the adjusted elevations on all bench marks when funds are available. Previous to 1935 several parties were at work on this phase but due to lack of funds this work has been stopped. Mr. Roberts can be of great help if he would join the present move for the completion of the mapping of the United States. Part of this mapping project is to complete the geodetic surveys which form the frame work of the geological survey quadrangles.

These men have managed to get through the last four or five years, hoping that when things do start up again they would at least be able to make a decent living once more. But will they? Not unless the employer of engineering talent undergoes a radical change of attitude.

What is the answer? Let us hear from some of the personnel men.

WALTER E. BROWN

Haddonfield, N. J.
Jan. 24, 1937

Collection Costs in St. Louis

Sir—In the article "St. Louis Grinds Its Garbage" appearing in the issue of January 14th, there is an error in the collection costs of garbage service. On page 61, top of center column the statement "Collection costs per capita————" should read "Collection costs per ton————".

FRANK J. McDEVITT
Director of Streets and Sewers

St. Louis
Feb. 3, 1937

More on Flood Formulas

Sir—The writers have noted with much interest the letter by I. Gutmann in your issue of Dec. 24, 1936, p. 905, which would seem to call for some explanation on our part.

It is not our intention to offer a new formula for flood flows. Experience of the past few years has shown that any flood flow is likely to be exceeded. Neither is it our intention to enter into any serious controversy in this matter. A formula has been proposed and has been criticized. Whether the formula be correct, or the criticism be justified depends on the evidence submitted.

Mr. Gutmann is correct in calling attention to an error in the plotting of an item on our chart. However, he is incorrect as to the number of the item. The item in question is Jarvis No. 41, and not No. 7. Also it is Mr. Gutmann's No. 5 and not No. 2. In addition, Mr. Gutmann's No. 28, and not No. 21, refers to Jarvis No. 493, but gives a much greater unit discharge than is given by Jarvis. To complicate the matter, this last item is not plotted, in either of its values, in Mr. Gutmann's chart.

With reference to the discharge measurements criticized by Mr. Gutmann, it should be sufficient to state that these were made by the U. S. Geological Survey, and we do not know that the measurements made by this survey have heretofore been seriously questioned.

It might be well to mention that the extreme floods in Texas we have listed have occurred in the "Balcones Fault" area. Within this area occur some of the most intense storms and highest run-offs recorded in the United States. Characteristics of the floods in this area are: very rapid rise, extremely high peak, and rapid recession. A very good example of this is the flood of Sept. 9-10, 1921, in the San Antonio River. (See U.S.G.S. Water Supply Paper No. 488, p. 40.) These characteristics lessen the chances of peak floods in tributaries coinciding with peak floods in the main stream.

With this explanation of general characteristics of the Texas floods, the specific criticisms of Mr. Gutmann may be discussed. As is only too well known, a flood tends to "flatten" as it goes downstream, so that, if there be no inflow between two gaging stations, the lower station will have a smaller crest discharge. The sharper the crest of the flood, the more pronounced is this effect.

First as to floods in the Guadalupe River. The table accompanying our chart showed a flow of 206,000 sec.-ft. at Ingram (Item 7), and 196,000 sec-ft. at Kerrville, 8 miles downstream (Item 16), both occurring on July 1, 1932. The flood of 138,000 sec.ft. in Johnson Creek, tributary of the Guadalupe, at Ingram (Item 5), occurred July 2, 1932, *one day later*. With this difference in time we cannot see any grounds for Mr. Gutmann's criticism. He has apparently assumed that the two floods were coincident, which is manifestly not the case.

The flood of 196,000 sec.-ft. at Kerrville, July 1, 1932, appeared as 182,000 sec.-ft. at Comfort, 18 miles downstream (Item 20), on July 1 or 2, 1932, the flattening effect being very well marked. With the larger part of the rainfall causing this flood falling above Ingram, one should expect, rather than criticize, this "flattening."

The formula shown on our chart was obtained by drawing a line through maximum points and parallel to Mr. Gutmann's line. It is not offered as a new formula, or a modification of any existing formula. Our objection is not so much to Mr. Gutmann's statement that his formula applies to areas of from about 1 to 70 square miles, as it is to his statement: "But it can also be used for estimating phenomenal floods in watersheds as large as 350 or 400 square miles, as seen from the graph. Within this range the formula offers a satisfactory, generous estimate of cloudburst floods based on the world's worst experience so far. It probably represents the maximum maximorum of flood flows for this geological era and climatic age."

Whether we have made a justifiable criticism of Mr. Gutmann's formula is for others to determine on the basis of the evidence submitted. Certainly we have shown, from sources heretofore considered reliable, that floods on areas of less than 400 square miles, far in excess of Mr. Gutmann's formula, have occurred. In fact, Mr. Gutmann's points Nos. 20 and 25 are well above his formula, and his points Nos. 27 and 28 (had they been plotted) would have shown that the line should have been given a much different slope. It should be noted that Mr. Gutmann's formula limits the total flow to a maximum of 100,000 sec.-ft., regardless of the area.

There does not seem to be a reasonable justification for rejecting a measurement because it exceeds a value given by a formula, when that formula (if it has any sound basis) must be based on these measurements. The more logical thing would be to question the formula.

JOHN W. PRITCHETT,
G. G. COMMONS,
State Board of Water Engineers

Austin, Texas
Jan. 29, 1937

Garbage Grinding

Sir—I read your article on the grinding of St. Louis garbage contained in the January 14 issue of *Engineering News-Record* and I think it presented the case very clearly.

I must take exception, however, to the editorial on p. 67 entitled "Garbage Grinding on Trial." We have demonstrated very clearly that this method of disposal is entirely feasible and satisfactory here in St. Louis and instead of questioning this method it might have been well to suggest that municipalities desiring to consider such a method might do well to employ some engineer who could investigate thoroughly all phases of the problem as applied to that particular municipality and render a report accordingly. Reading between the lines the editorial seems to be "damning with faint praise" our system of disposal.

FRANK J. McDEVITT
Director of Streets and Sewers

St. Louis
Jan. 20, 1937

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February 18, 1937

The Flood Passes

AS FORECAST last week, the Ohio-Mississippi flood is passing uneventfully to the Gulf. Its menace to the upper reaches of the alluvial valley was not maintained farther down, and the Boeuf valley was kept free from inundation. Soon the record of the tremendous wave that had its origin along the Ohio's tributaries will receive the intensive study that it deserves and that the permanent protection of the valley demands. The magnificent performance of Gen. Ferguson's cutoffs takes a leading place among its lessons; their success in increasing the flow capacity of the channel so greatly as to lower the flood level some ten or twelve feet below the height it would otherwise have reached surpassed every expectation and is the most impressive new development in the Mississippi's history since the control of the river was first formally recognized, 57 years ago. What the flood has taught about the value of cutoffs and straightening of levee lines appears of such high value, in fact, as to weigh up a substantial part of the flood losses.

Flood Follows Flood

A NEW FLOOD has already developed, but this time it is falling on the President and the Corps of Engineers instead of the hapless citizens of the Ohio and Mississippi valleys. It is a deluge of plans for ending all floods in those valleys. The same sort of deluge developed after the great 1927 flood, and to a lesser degree last March. Strange as it may seem, the proposed schemes come from regions far removed from the Mississippi—from coast or lake cities and even prairie towns. They cover the entire range of the fantastic, from making the Mississippi into a paved channel to tapping the Missouri by a new river cut southward across the country, or leading excess waters to the Great Lakes. All have one thing in common; they show utter lack of comprehension of the magnitude of the problem of carrying two or three million cubic feet of water per second safely to the Gulf. To those who would tame the Mississippi we recommend that first of all they go to a point like Cairo or Memphis when the river is in flood and stand on the levee to observe the vast body of water as it sweeps relentlessly to the sea. No one can truly realize the scale of the problem until he has seen that sight. The humblest and most cautious planners of river-control systems are the very engineers who know most about the Mississippi River.

Not Much Progress

APART FROM THE FLOOD, Washington happenings and opinions lead in the developments of the past week. A report on the unstable condition of the Great Plains region and what might be done about it follows on proposals for reorganizing the government departments and courts and publication of the countrywide drainage-basin study. Proposals for numerous river Authorities or regional supergovernment councils mirror vague plans for extending federalization of our systems of public administration by way of large expenditures from the federal treasury, but contain little evidence of any consistent or clearly-thought-out policy on national affairs or on the development of our resources. Under the circumstances it is not strange that the President's message transmitting the Great Plains reports puts forward as a new discovery something that has been well known for nearly half a century, namely that "rainfall for considerable periods falls below the critical point at which it is possible to grow crops by the agricultural methods common to the humid regions." Were a clear-cut program advanced to take care of this newly discovered condition, the situation might be more encouraging. As it is, national resource problems merely muddle along.

More Authorities

TYPICAL OF THE MENTAL ACROBATICS that are being indulged in with respect to improving the country is the proposal of a U. S. Senator to create a flock of river Authorities, on the model of the Tennessee Valley Authority. The plan might be commended if the purpose were to spend large amounts of public money quickly; it is less commendable if the purpose is to accomplish something constructive on a sensible business basis, especially where state and local action is involved. The TVA, the initial experiment in federal Authorities, is still very far from having made a success, and until it comes nearer to solving the problem of businesslike regional improvement there can be no reasonable excuse for setting up additional bodies of the kind. As was set forth in our review of the Tennessee Valley Authority's activities (*ENR*, Dec. 31, 1936, p. 929) that organization has done nothing toward working out methods of cooperation with local interests and has failed utterly to make a showing of business justification. Any attempt to set up a balance sheet of economic or social benefits of TVA work against its hundred million dollars of expenditure is badly disappointing. In the face of this condition plans to set up more such Authorities should promptly be consigned to the wastebasket.

Protecting Our Own

FLOOD PROTECTION IS NOT ALL LEVEES, headwater reservoirs and fuseplugs. These constitute merely the first line of defense and are costly beyond reason if built for full protection without supplemental aid from the individual property owner, whether merchant, public utility, manufacturer, or city water or sewer department. The importance of individual flood protection was emphasized by its absence in the Ohio valley flood—as it has been in all previous floods. City business districts, public and private power plants, vital municipal services and industrial plants were located in the stream courses where inundation sooner or later was inevitable; yet, except for a few sandbags these properties were wholly unprepared. Insofar as municipal services and public utilities are concerned, the cities themselves must be the judge; the economy argument for locating vital motors, generators and pumps below flood level loses some of its potency when arrayed against the possibility of failure of electric light or water supply. The private owner, merchant or manufacturer is in a somewhat better position to decide his course of action; if flood protection costs him more than a periodic wetting, he can forego

it, while if his studies show the reverse he can follow the example of the Joseph Horne department store in Pittsburgh, whose elaborate bulkheading system is described in this issue. In any event our future flood-control thinking must not disregard the necessity for individual flood protection systems. Federal and state responsibility does not extend to complete protection for those who insist on locating in the flood plain.

The King Is Sometimes Wrong

REPRODUCED IN FULL in this issue is the significant opinion of Judge Whaley in the Trenton post office suit. So many inquiries for fuller information have come to this journal since a brief summary of the opinion was published in our issue of Dec. 18 that it seems desirable to publish the complete opinion in order that contractors on government work may recognize its full significance. Too often in the past the federal government's representatives on contract work have taken the attitude that "the King can do no wrong," that the government or its representatives are always right. Judge Whaley effectually disposed of that idea. Further, he declared that the Comptroller General cannot overrule a finding of the Supervising Architect with respect to a federal building contract because it is the Supervising Architect, not the Comptroller General, who is party to the contract. Judge Whaley's opinion is worth reading; he makes it clear that the government can also be wrong.

Crack Down!

CALLING ON CONGRESS to penalize motor vehicle tax diversion, Representative Cartwright, who with Senator Hayden leads in championing federal aid in the national legislature, served a needed warning a few days ago. No logical excuse exists for the national government to continue to hand out roadbuilding millions to states to replace highway money diverted and redistributed for political purposes. Curtailed federal aid is the only argument that these states will respect. In general they are the states of greatest wealth: New York and New Jersey are examples. Executives or legislators of both states have year after year dipped into the road-tax treasuries and this year propose to make the robberies greater than ever. The arguments that road transport is being hampered, that improvements are needed to safeguard life, and that the road taxpayer is entitled to honest treatment, have proved ineffectual. Until the taxpayers arise to demand laws preventing diversion as they did last fall in Maine and until a federal Congress refuses to replace diverted road taxes, states will continue to juggle them by diversion and redistribution.

Safer Building

ONE OF THE WEEK'S helpful developments is a promising attack on the old problem of assuring safe building. A committee of the New York Building Congress headed by Aubrey Weymouth has drafted an ordinance excellently adapted to placing building on a sound, secure basis; whether it will be adopted by the city authorities remains to be seen, but there is at least a possibility of this result. The provisions of the draft represent a simplified version of those developed some twelve years ago by engineering and architectural societies of the New York building region. Essentially they require that one who proposes to build shall employ a licensed architect or professional engineer to prepare and file plans, check shop drawings, supervise construction, report progress monthly to the building department as well as the owner, and present a final statement of adequacy in applying for a certificate of occupancy. Through these provisions the proposed law attaches competence and responsibility to every building operation. It is worth attention on the part of other cities as a means of doing away with poor and unsafe building.

A Bread-and-Butter Question

SIX OR EIGHT MILLION MEN together with their wives and children depend for a livelihood on the construction industry. It is tragedy to this large army when depression threatens the complete collapse of construction, as it did four years ago. They are vitally concerned to know what are the motive forces of construction activity. To engineers, who are a constituent part of the construction army, this is very much a bread-and-butter question, but it is hardly less so to the community at large, since the wellbeing of every industry and craft, even of the investor, is involved.

Little has been known heretofore about the forces and movements that constitute the mainspring of construction. A beginning of such knowledge is represented in the analysis presented by L. J. Chawner in this issue. Some significant relationships are suggested, but at the same time it is made clearly evident that the problem as a whole is an intricate one. The great importance of continuing the study is therefore obvious.

One of the significant features of the analysis is its bearing on the argument for wise public-works management. As the chief controllable diversion of construction, public works represent the primary means by which the catastrophic oscillations in construction can be controlled and the resulting loss and misery prevented. Though we are still very far from knowing how public works can be managed in this beneficial way, we will at least have gained if we succeed in understanding their effect.

The analysis already indicates that construction activity is influenced by several independent groups of factors. Commercial and industrial building is directly dependent on production; when manufacture stagnates, the building of mills and factories also must stagnate, while on the other hand there is sure to be much industrial building when production is active. In this field, then, boom begets boom, while depression brings forth depression, and it is doubtful if anything can be done to steady these swings.

Quite different relations characterize the even larger field of housing. The influence of mortgage practice, of security of home ownership, of sound building practices, is unmistakable, and back of these are the more obscure factors of general earning power, social conditions, and immigration. How far these complex factors can be controlled so that housebuilding will be made more stable remains obscure.

In public works, third great division of construction, therefore, lies the main dependence for checking depression collapse. Present opportunities for utilizing this resource are severely limited by weaknesses of public finance that have been painfully evident for nearly five years past. But when ways are found to remedy these weaknesses, and our systems of planning and program improvement construction are better developed, there is prospect of some headway against depression and panic.

CURRENT NEWS

Regulations Issued For Federal Aid

Bureau issues regulations for federal-aid to secondary roads and grade crossing elimination

Rules and regulations governing the expenditure of $25,000,000 of federal-aid for secondary roads which was apportioned last December to the various states were approved by the Secretary of Agriculture Feb. 9. The funds are to be administered by the Bureau of Public Roads in cooperation with the state highway department.

The new funds, which, as with other federal aid, must be matched by equal amounts of state funds, are for expenditure on secondary highway construction projects initiated by the various state highway departments and approved by the Secretary of Agriculture. The funds become available July 1 for payment to the states for completed work, and remain available for two years.

The regulations define secondary or feeder roads as including farm-to-market roads, mine-to-market roads, rural free delivery mail roads, public school bus routes, and other important secondary roads. To qualify for assistance on such roads, the regulations provide that each state must select a system of important secondary highways not exceeding 10 per cent of its highway mileage. The selection of roads to be included in this secondary highway system must be based on facts obtained from a highway planning survey in each state, and federal funds for secondary roads can be expended only on this system. Until such a system is designated, projects may be approved where it may reasonably be anticipated that the road constructed will become part of the designated system. Highway planning surveys that will supply information needed in selecting secondary road systems are well under way in 40 states, and, in many, field work is nearing completion. These surveys are being made cooperatively by the state highway departments and the Bureau of Public Roads and are being financed largely with federal funds.

The secondary highway systems will be essentially rural in character, although within municipalities sections linking important secondary highways with other main highways may be included. Highways which are now parts of the federal-aid highway system or which are likely to be added to it cannot be included in the secondary system.

All work done, the regulations emphasize, must be consistent with traffic needs. Grading and drainage as first stage construction will be acceptable providing the state agrees to place surfacing or to improve the roadbed later. The regulations specify that the state must maintain in satisfactory condition all roads improved with federal funds.

In order to obtain a wide distribution of benefits within each state the chief of the bureau of public roads is authorized to determine the minimum percentage of counties in which the funds authorized for any one or more fiscal years shall be used. This percentage is to apply in each state.

Grade crossing elimination

The Secretary of Agriculture on the same day approved also regulations for the administration by the Bureau of Public Roads of the $50,000,000 federal fund for continuing through the next fiscal year on a permanent basis the program of railroad grade crossing elimination. These funds, which were authorized by Congress in June, 1936, were apportioned among the various states on Dec. 29, 1936, and will

(*Continued on page 282*)

Prompt State Action Urged On Connecticut River

The Secretary of War on Feb. 9 addressed letters to the governors of Vermont, Connecticut, Massachusetts and New Hampshire pointing out that the construction of a reservoir system for the control of floods in the Connecticut River valley at an estimated construction cost of $10,000,000, provided for in the flood control act of June 1936, was made subject to the acquisition by local agencies of land and the payment by such agencies of damage claims. The letter stated that inasmuch as the War Department appropriation now pending before Congress includes funds to be applied to the projects authorized in the flood control act, assurances must be provided by the states at an early date that the conditions of local cooperation will be fulfilled if a definite allocation of funds is to be made to permit construction operations to be placed under way when the appropriation becomes available.

The Secretary pointed out the interest of the administration in an early start of construction on the projects and suggested that a conference between representatives of the states with this end in view might be of value. He agreed to attend such a conference with personnel from the War Department qualified to explain the plan in full detail and assured the governors of the desire of the department to cooperate in a helpful way in effecting the necessary agreement between the states and the federal government to permit the consummation of the program. At such a conference, the Secretary stated, the Merrimack Valley program could also be discussed with representatives from the states of New Hampshire and Massachusetts.

Commissions representing the states of Connecticut, Massachusetts, New Hampshire and Vermont have been conferring with a view to effecting the necessary agreement between these states to permit construction operations to be placed under way in the Connecticut valley, but no definite agreement has yet been effected.

Road Laws Proposed By N.Y.S. Commission

Bills introduced in New York Legislature carry out recommendations of joint legislative highway commission

Eleven bills have been introduced into the New York legislature designed to carry out the recommendations of the joint legislative commission which has been studying the highway situation in the state for the past three years. The recommendations are substantially the same as were contained in a preliminary report submitted by the joint survey commission a year ago except that they are supplemented by specific bills to carry out the recommended procedures.

The proposed bills would accomplish the following:

The state would acquire and pay for the rights-of-way for all state highway projects.

The cost of highway building would be met by imposition of a permanent two-cent gasoline tax and a temporary one-cent tax with the continuation of the present motor vehicle license tax. It is provided that all funds derived from these taxes should be used exclusively for highway and bridge purposes.

The average annual appropriation and expenditure for highways and bridges, which now amounts to about $30,000,000, would be increased to about $80,000,000; this would be entirely derived from current revenue, estimated at more than $80,000,000, which would be collected from vehicle taxes and the three-cent gas tax if it were not diverted to other purposes.

The state would furnish state aid to counties outside of the city of New York to the extent of $4,000,000 a year and to the city of New York for arterial highways and bypass highways, to the extent of $4,000,000 a year.

Apartment House Collapse Brings Six to Trial

The trial of the six men who were indicted for second degree manslaughter in connection with the collapse of an apartment house building in the Bronx, New York City, last June (*ENR*, June 25, 1936, p. 930), began in the Bronx County Court on Feb. 16. Seventeen workmen were killed in the collapse.

The defendants are Louis Steinberg and his son, Max, officers of the Mosholu Housing Corporation which was erecting the fallen building; Harry B. Rutkin, an architect; Albert F. Heine, an inspector of masonry and carpentry in the Bronx Bureau of Buildings; Michael C. E. Theide, a plan examiner in the Bureau of Buildings, and Vincent Valentine, a masonry contractor on the job.

It is expected that many noted engineers will be called upon to testify in the case.

Auditorium Bill Passed

Congress has passed a bill setting up a five-man committee to examine into costs, possible sites, and methods of financing a large auditorium for the city of Washington. Construction of such a building has long been advocated and was accelerated by the bad weather experienced during the President's inauguration ceremonies.

The committee will be composed of the chairman and ranking minority members of the Senate and House committees on public buildings and grounds and the Secretary of the Interior.

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Flood Crest Flattens Out

Mississippi River flood continues above previous levels but will be below early peak predictions

The crest of the Missisippi River flood was passing Helena, Ark. at the end of the week after having reached a stage of 60.28 on Feb. 13, or 3.53 ft. above the 1927 record. Evidence that the flood crest was flattening out was found by the army engineers in the fact that up to Saturday night the gage had been close to 60.25 for over 48 hours.

Conditions on the St. Francis, White and Arkansas rivers were reported by Lieut. Col. E. Reybold as at a standstill, and barring further heavy rains no increase in flood levels is expected.

Sandboils and seepages are increasing, as is usual when the levees are under flood conditions for long periods, but no trouble is anticipated.

A large sandboil was reported as having caused extensive flooding in New Orleans on Friday, but the flow was checked by sandbagging. Subsequently, according to J. F. Coleman, it was determined that the trouble was caused not by a sandboil but by a buried pipe beneath the levee which had been lost sight of. The flooding reports were not correct. The flow was carried off in street ditches.

By Feb. 12 the flow through Bonnet Carré spillway above New Orleans had increased to 140,000 sec.-ft., following the opening of the spillway on Jan. 31. As the New Orleans gage continued to rise, having reached 18.2 ft. on Feb. 12, Lieut. Col. W. F. Thompkins ordered the opening of additional sections of the spillway increasing the discharge by 20,000 sec.-ft. The result was that the New Orleans gage stood stationary at 18.2.

Flow into Lake Pontchartrain through Bonnet Carré spillway raised the lake level 1.6 ft.

SUBMERSIBLE TAINTER GATE

A VIEW of the downstream face of eight submersible tainter gates built as a part of Dam No. 11 at Dubuque, Iowa, one of the dams being constructed in the 9-foot canalization of the Upper Mississippi from St. Louis to St. Paul. Each tainter is 60' long and makes possible a pool 20' deep above sill elevation. Designed for a maximum submergence of eight feet or to be raised so that the lowest point on the gate is 5' above highwater, the gates are among the most recent developments in tainter gate design. They are to be of special value for ice discharge and will make possible a more effective stilling basin. The entire movable section of Dam No. 11 will consist of 13 tainter and three roller gates each 100' x 20'; the nonmovable section consists of a 200' storage yard and several hundred feet of nonsubmersible earth dam. Dam No. 11 is being built by Maxon Construction Company of Dayton, Ohio, with a contract for $2,358,867. The lock was built by the Warner Construction Company, Chicago, Illinois, at an approximate cost of $1,500,000.

St. Lawrence to Be Bridged In Thousand Island Region

A new toll bridge is to be built over the St. Lawrence River between Ivy Lea, Ont. and Collins Landing, N. Y., according to an announcement made by the Thousand Island Bridge Authority (American) and the Thousand Island Bridge Co. (Canadian). Financing arrangements have been completed and bids have been called to be opened on March 2. Construction is to be completed by October 1938.

The new bridge will be in the neighborhood of Alexandria Bay, on the New York side, and about midway between Brockville and Kingston on the Ontario side. Its total length including approach highways will be nine miles. Beginning at the Canadian end there will be 3,428 ft. of bridge structure, including a 750-ft. span suspension bridge with 300-ft. side spans, a highway across Wells Island and 4,260 ft. of bridge at the American end, including a suspension bridge with an 800-ft. main span and 350 ft. side spans. Approaches to the suspension bridges will be of steel plate girder viaduct type, and there is a 90-ft. span concrete rigid frame planned between Wells and Hill islands over the international boundary. The estimated cost of the bridge structures is $1,800,000.

Designing engineers are Robinson & Steinman, New York. Monsarrat & Pratley, Montreal, are consultants on the Canadian portion of the work.

Under the proposed plan of construction, the work on each side of the international boundary will be done by domestic corporations employing native labor.

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A.I.S.C. Design Competition

The ninth annual design competition of the American Institute of Steel Construction will close April 12, 1937. An innovation this year consists of the offer of three cash prizes instead of the two previously offered. The best design will receive an award of $150, the second $100, and the third, $50.

The subject of the competitive design is a steel highway bridge to carry a four-lane highway, 40 ft. between curbs, and one 5-ft. sidewalk in a straight line across a navigable stream 300 ft. wide from bank to bank, connecting a parkway on high land to the south with a boulevard on the plateau to the north. Suitable lighting is to be provided.

MISSISSIPPI RIVER STAGES AND DISCHARGES FROM U. S. GEOLOGICAL SURVEY

Location	Date	1937 Peak Gage Height	1937 Peak Discharge in Sec.-Ft.	Previously Recorded Maximum Stages Year	Previously Recorded Maximum Stages Gage Height
Mississippi River at:					
Memphis, Tenn.	Feb. 9	48.65	1,920,000 (peak)	1913	45.2
Vicksburg, Miss.	Feb. 15	52.48	2,020,000	1927	58.4
Natches, Miss.	Feb. 15	56.7	.....	1927	56.5
New Orleans, La.	Feb. 13	18.2*	.....	....	....
Atchafalaya River at:					
Krotz Springs, La.	Feb. 15	36.3	395,000	....	....

*Figure from district engineer's office, New Orleans, with 160,000 sec.-ft. discharging through Bonnet Carré spillway.

A Map Program Given Congress

Secretary of the Interior recommends a 20-year program of topographic mapping to cost $100,000,000

Of the continental United States, exclusive of Alaska, 25 per cent is adequately mapped with maps not more than 40 years old. Forty-six per cent of the country is entirely unmapped; 24 per cent is inadequately mapped with old maps; and 5 per cent is covered only by maps which do not show contours.

Starting with these facts, the Secretary of the Interior has submitted, in response to a request from the Senate, a program for expediting the topographic mapping of the United States.

The report, submitted Jan. 29, states that it is impossible to make detailed estimates so far in the future of what will be the most pressing need for topographic mapping and has therefore submitted a report which is in broad terms, is for a limited period, and provides for less than a complete schedule of operations that will eventually be required to meet the needs of the nation. It presents a general estimate of the cost of a 20-year program, but does not attempt detailed estimates for each year of such a program. The report states that "If the present Congress is willing to accept and endorse the principle that the needs of this nation require far greater speed in map making than has prevailed in the past, and will make provision beginning with the fiscal year 1938 for this accelerated progress, it is believed that it will have done all that is practicable to do at present."

It is recommended that a program for present consideration should contemplate the mapping of about 1,500,000 sq.mi. that would include much of the unmapped in the inadequately mapped region and the addition of contours to most of the maps in the partly mapped area.

It is recommended that such a program be considered for a period of 20 years, involving mapping of all types at an average rate of 75,000 to 80,000 sq. mi. annually. The cost of the mapping itself, the report states, exclusive of first and second order triangulation and leveling would be about $80,000,000, or $4,000,000 annually, and the cost of the triangulation and leveling would amount to about $20,000,000 more, thus constituting a $100,000,000 program involving total average annual expenditures of $5,000,000.

It is recommended, therefore, that Congress adopt a program for expediting the topographic mapping of the United States which would include the following items:

The acceptance of the principle of a 20-year program, and the expenditure of $100,000,000 during that period as a general guide for legislative action.

An appropriation of $4,000,000 to the Geological Survey for 1938, of which about $3,000,000 would be required for topographic field surveys, about $675,000 for editing, engraving, and printing of the maps, and $325,000 for office and incidental expenses.

An appropriation of $1,000,000 to the Coast and Geodetic Survey for 1938 for first and second order triangulation and leveling.

It is recommended that the program outlined should be entirely federal, but that the present provision that states and civic subdivisions which desire to expedite the work within their jurisdiction may contribute funds to these ends through the medium of cooperative agreements should be continued.

The Secretary states that such a program would not complete the mapping of all the unmapped areas of the United States and its possessions nor provide for all of the revision that will be required, but if definitely adopted it will permit substantial progress to be made in the relief of the present extremely unsatisfactory situation, and under it the most acute needs can gradually be relieved. Moreover, it is felt that such a program can be organized effectively during the first year of its operation and be fully under way thereafter.

Great Plains Problem Declared A National Responsibility

Reporting to the President on the results of its three-month survey "to determine on a long-term program for the efficient utilization of the resources of the Great Plains area," a special committee headed by Morris L. Cooke has outlined courses of federal, state and local action and recommended the establishment of a continuing territorial agency to coordinate the work and make a long-term program effective. In addition, the 127 page report describes the physical characteristics of the area, reviews the use and misuse of the land and presents a number of special memoranda on the question of new investment capital and credit and on taxation problems as well as outlines of various state laws relating to soil and water conservation.

Deterioration of a vast agricultural area resulting from uninformed farming practices has brought about such severe social and economic decline that concerted national action is demanded, according to the committee. It recommends:

For the federal government—

(1) To institute topographic, hydrographic and soil surveys; studies of possibilities for 500- to 1000-acre irrigation projects (since small runoff and inadequate underground storage make large projects impossible); and studies of the proper size of farms and of the cause and cure of erosion.
(2) To continue purchases of crop farms in large grazing areas or elsewhere if they can be leased to grazing associations.
(3) To aid in increasing the size of farming units.
(4) To further the surface-water conservation practices instituted by the Soil Conservation Service such as contour and strip planting and the building of small reservoirs for stock watering and erosion control.
(5) To study resettlement problems but in general to defer formulating a program until necessary readjustments of land use are worked out.

For the States—

(1) To revise and extend present laws relating to land and water use and conservation, to tenancy, taxes, etc.
(2) To pass laws enabling counties to zone land use in a manner similar to that now employed in cities.
(3) To sanction cooperative grazing associations that would operate on large tracts of land held under different ownerships.
(4) To permit the formation of soil conservation districts for cooperative work by the land owners.
(5) To aid farmers in water conservation and control practices.

Finally, for individual farmers, it is recommended that they work toward more intelligent farming practices and water utilization and extend cooperation in the working out of a long-term plan.

To bring the work of the many federal, state, county, municipal and district agencies together on such a long term plan for rejuvenation of the drought-ridden Great Plains, the committee recommends the establishment of a continuing territorial agency. Such an agency, it is stated, would not displace existing agencies or assume any administrative control over the operations which those bodies normally carry on. Its function would be that of continuing the studies of the Great Plains problem and of endeavoring by consultation, education and guidance to integrate the efforts of all concerned.

The report was transmitted to Congress last week by the President for the information of the Congress and without recommendations.

First Contract Called Soon On Central Valley Project

The first construction contract on the Central Valley federal reclamation project in California, covering four miles of the Contra Costa Canal, will be advertised for bids immediately.

The Central Valley project is designed to conserve and redistribute the waters of the Sacramento and the San Joaquin Valley to relieve the water shortage in the San Joaquin Valley and to correct the intrusion of salt water from San Francisco Bay in the San Joaquin-Sacramento Delta region.

Funds were appropriated for the project at the last congress, and about $11,400,000 is available for initiation of the work—$6,900,000 of appropriated funds, and $4,500,000 allotted from emergency appropriation.

The project is divided into three divisions: the Friant division in the San Joaquin Valley; the Contra Costa division, which will serve farmlands in Contra Costa County and provide water for cities on the south side of the Suisno Bay; and the Kennett division in the northern end of the Sacramento Valley.

Construction of a dam on the San Joaquin River and a distributary canal in the San Joaquin Valley is contemplated in the Friant Division. In the Contra Costa division a canal will be constructed from Rock Lough to the vicinity of Martinez. A large storage dam is contemplated in the Kennett division for the purpose of regulating the flow in the Sacramento River so that salt water intrusion can be prevented in the delta area, and so that a flow ample to permit diversion of water needed in the San Joaquin Valley will be available throughout the year. Flood control benefits will accrue, and navigation will be improved. A hydro-electric development is also contemplated in connection with this dam.

Flood Conferences Disagree On Control Procedures

Two conferences of Ohio Valley interests called to consider means of preventing a recurrence of the recent flood in the Ohio Valley have reached divergent conclusions as to the allocation of responsibility for such work, a conference called by the Ohio Chamber of Commerce recommending Federal flood control work under supervision of the U. S. Engineers, while a conference called by the Council of State Governments would assign primary responsibility for the work to an interstate commission of Ohio Basin states.

The Council of State Governments on Feb. 1 issued a call for state commissions on interstate cooperation from states in the Ohio basin affiliated with the council and for representatives from Tennessee and Illinois, which have not yet established such commissions, to meet in Columbus, Ohio, Feb. 5-6 to consider a program of long-range action on the problem of flood control.

The conference rejected a proposal coming from Ohio, Kentucky, and West Virginia delegates that the federal government be asked to assume entire responsibility for flood control in the basin and adopted a resolution stating that "It is the realization of this conference that the flood hazards in the Ohio basin present problems beyond the individual abilities of the states to solve alone, they being both emergency and long-range matters, and that they are the responsibility of the federal government, the interstate commission, and the individual states, each to cooperate to its full ability and according to its respective responsibilities."

Action was taken looking toward the formation of a permanent interstate commission in the Ohio basin to be composed of three representatives from each of the nine states affected by Ohio River floods. The recommendation of the council was that the delegation from each state would be composed of a member of each of the Houses of the state legislature and a third member be appointed by the chairman of the state committee on interstate cooperation if one exists or by the governor if there is no such committee, each member to serve for a term of one year.

Opposite view expressed

A directly contrary stand on the problem was taken by the Ohio Valley Flood Control Conference held in Columbus Feb. 3 under the auspices of the Ohio Chamber of Commerce. The conference, of about 500 public officials and business leaders from the nine states in the Ohio River watershed, expressed its endorsement of the secrest-Bulkley Bill now before the Congress of the United States which would establish an Ohio Valley Authority and provide supervision of construction by the U. S. Engineers. The conference held that there was an immediate necessity for the construction of impounding reservoirs and control work in the headwaters of the Ohio River and its tributaries and held that the whole expense should be borne and the authority vested in the federal government, including the acquisition of property, the asumption of necessary existing obligations, and the maintenance of the structures in the future. It was also recommended that the Overton and Copeland flood control bills be so amended as to eliminate the provisions for local payment of land acquisition and damage charges. It was also recommended that the proposed work in the Ohio Valley should be the first step in a national program to protect the lower Mississippi Valley.

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Conference of Surveying Teachers to Be Held in July

About 40 teachers of surveying from many parts of the country will meet July 25-Aug. 7 at Camp Marston near Ranier, Minn., for a conference on the problems of the teaching of surveying held under the auspices of the Society for the Promotion of Engineering Education by the civil engineering department of Iowa State College.

A tentative program allocates one particular subject for discussion on each day of the conference; each one of the programs will be developed as a round-table, with about four designated speakers to discuss the main subject after it is opened by a principal speaker.

The subjects tentatively laid out range from such general questions as the content of the surveying course for civil engineers and methods of teaching and assigning work, to such specific questions as the care and maintenance of surveying instruments for student use and the teaching of aerial surveying.

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New Flood Bills Would Create Ohio River Authority

Legislation providing for the creation of a three-man Ohio River Authority to take over flood control in the Ohio basin has been introduced in to both houses of Congress by Senator Bulkley and Representative Secrest, both of Ohio. The three directors would be empowered to use funds for land purchase, reforestation and dam, reservoir and canal construction with instruction to secure the maximum amount of flood control, navigation benefits, and benefits to the economic and social well-being of the valley's inhabitants. The necessary construction work would be placed in the hands of the Corps of Engineers. The bills carry an authorization for $150,000,000.

Other proposed legislation inspired by the recent flood included: a nation-wide study of flood control measures for all major streams in the nation, to be conducted by the Corps of Engineers, proposed by Senator Caraway and Representative McClellan; a bill to create a Department of Inland Waterways, to be headed by a cabinet secretary who would "initiate, plan, systematize and direct the construction, maintenance and operation of all projects for flood control, navigation, irrigation, pollution abatement, municipal water supply, and power development," by Representative Gray of Indiana; various resolutions proposing emergency relief appropriations for the benefit of the flooded areas.

President Asks Regional Planning

Roosevelt favors planning regions rather than watershed authorities—Says local contributions to flood control not working

Washington correspondence

President Roosevelt, at his Feb. 9 press conference, called attention to the fact that a dozen or more different watershed authorities are being proposed in Congress and stated that it was his opinion that it would be preferable, in the interests of orderly planning, to set up eight or ten regions that would cover the country without undue emphasis on any one watershed or without having separate organizations on too many small watersheds. These regional administrations, the President said, would have the task every year of submitting a list of projects on flood control, drought damage, soil erosion and other projects in their particular region, with projects classified in order of preference.

Budget procedure

Reports from all these regions would be considered by the Bureau of the Budget and an estimate made of the total amount that should be spent on such projects in the nation as a whole. The Bureau would break this figure down for the different regions, and each regional authority would draw up a preferred list to fit its budget figure. The list would then be submitted to Congress in the budget along with a secondary list of projects not included in the budget. Congress would then have the option of removing projects from the budget list and substituting others if it saw fit.

This plan, the President thinks, would enable floods, dust storms and other conditions to be considered by the same planning agency, increasing efficiency and possibly making a saving over present expenditures because the planning is now being done by a dozen different government agencies.

It is the President's present idea that the expenditures of these planning agencies would come within the $500,000,000 which he had previously recommended as a normal annual expenditure for public works by the federal government.

In working out the regional planning, some of the regional agencies might have administrative duties like the TVA. President Roosevelt stated that this plan ties in with the omnibus flood control act and would give a chance to review the act which was rather hastily thrown together.

Local contributions not working

The president also expressed the opinion that the principle of local contribution to flood control work is not working out. He cited the New England flood control work on the Connecticut and Merrimac rivers where four states have tried to get together by the state compact method to buy the land needed for flood control, with no land purchased as yet. It is obvious, he said, that the states and local interests should pay some part of the cost when they definitely benefit, but the prorating of the contributions involves great technical difficulty.

Professional Consolidation in Canada Advanced to Voting Stage

Engineering Institute of Canada to ask its members to vote on a proposal to bring the provincial professional associations of engineers into affiliation with the Institute as component associations with their members classified as associates

Consolidation of professional and technical activities of engineers in Canada through close cooperation between the Engineering Institute of Canada and the provincial professional associations was advanced appreciably at the fifty-first annual meeting of the Institute held in Montreal Jan. 29-30. Proposals made to the meeting now go to the members for vote. The meeting was confined to business matters as the Institute plans to hold its semi-centennial in June, at which time technical subjects will be taken up.

The whole of Friday was devoted to discussion of the final report of the committee on consolidation, a special committee appointed at the 1935 annual meeting to review the question of coordinating the activities of the Institute with those of the professional associations that now exist in all the provinces except Prince Edward Island.

Study begun in 1935

The consolidation committee, representative of all grades of membership in the Institute, with Gordon Mc. L. Pitts of Montreal as chairman, made its first report to the last annual meeting of the Institute, held in Hamilton, Ontario, in February 1936. That report, after a full day's discussion, was unanimously adopted "in principle as a progress report," and the committee was charged to continue its work in cooperation with the council of the Institute and to add to its number two members of the dominion council of the professional associations. (An account of this discussion, together with a brief historical note reviewing the progress of the professional movement in Canada, will be found in *ENR*, Feb. 20, 1936, p. 290.)

This year the committee submitted a set of definite recommendations for the consideration of the Institute. These consisted of proposed revisions of the by-laws of the Institute, and proposed forms of agreement between the provincial associations, also changes in the requirements for admission to the Institute under the new conditions.

Full cooperation sought

Basically, machinery is provided for the full cooperation between the professional associations and the Institute in such a way that eventually a common membership may be achieved, this without any change in the status of present members of the Institute, unless made voluntarily, with the exception that in future there will be only one grade of membership, that of member, all present associate members becoming members if the new by-laws are approved. Cooperation is to be achieved by the drawing up of an agreement between the Institute and any association desirous of taking the step, whereupon the association will become a "component association." This will entitle it to have an official representative on the council of the Institute. These association councillors will constitute a special standing committee of the council, to deal with association affairs. Its chief function will be that of assisting the associations in securing improved legislation, promoting the adoption of uniform standards of examination and membership, and encouraging the granting of reciprocal privileges between associations. All members of a component association who are not members of the Institute will automatically become associates of the Institute, unless they decide to join the Institute as full members, this being facilitated under special arrangements suggested by the committee.

In particular, the Institute will recognize membership in an association as requisite standing for membership in the Institute, this being regularized by the proposed by-laws although the practice has been unofficially followed to some extent for some time. The component associations will agree to pay a fifty cent fee per capita of their practicing members to the Institute, per year, thus providing funds for the activities of the committee on association affairs. Arrangements may be made for the associations to collect both their own and the Institute fees of their members, thus eliminating some of the existing duplication which is one of the factors responsible for recent progress. Finally, the Institute is to undertake that, in future, "no person residing in any province in which there is a component association shall be admitted as a member of the Engineering Institute of Canada unless he be a corporate member of such association."

Some disagreement

It is with regard to this last suggestion only that the committee on consolidation and the council of the Institute did not agree, and about which discussion centered at the meeting. The council had advanced an amended form, introducing after the word association (as quoted above) these words:— ". . . who is required by law to be a member of that component association. . . ." In discussion, this amendment was supportde by a number of members who expressed fears that the Institute would lose its autonomy to the associations if the proposals were accepted, suggesting that acceptance of the associations requirements for membership was tantamount to a lowering of the entrance requirements of the Institute. Other objections also were advanced, amongst which was the idea that the technical functions of the Institute and the legal functions of the associations should be kept quite distinct.

Report adopted

After extended discussion of the controversial points raised, the report of the committee was adopted and its recommendations are to be submitted to the membership for approval or disapproval. The result of the ballot will be known before the special business meeting to be held in connection with the semi-centennial in June.

Regulations Issued For Federal Aid

(*Continued from page 278*)

become available for expenditure July 1.

These new funds are in addition to an initial appropriation of $200,000,000 of emergency funds.

The new program closely resembles the program now going on. Five types of grade crossing elimination, protection and development are eligible: separation of grades at crossings; installation of protective devices at grade crossings; reconstruction of existing grade separation structures; relocation of highways to eliminate grade crossings; and relocation of railroads to eliminate grade crossings. The funds are available to pay the cost of construction exclusive of costs of rights-of-way or property damage and can be spent either on rural highways or on city streets. As with the previous program, no contribution from the railroad is involved.

Where legal authority exists in a state for the physical closure of railroad grade crossings and where, by the construction of a grade separation structure with adequate approaches, the use of an existing grade crossing structure is rendered unnecessary for the convenience of the general public, the regulations require that provision be made for the physical closure of such grade crossings after completion of the new structure. Any lateral connection necessary to accomplish the physical closure of such existing grade crossings may be included as part of a project.

In order to insure a fair distribution of benefits among the railroads in each state, the regulations require that improvements shall be divided among the various railroads so that the amount expended on each shall be about in proportion to its mileage. On each railroad, crossings of the greatest hazard to traffic are to be selected for elimination or protection.

Indirect-Direct Labor Ratio 2.6 On Post Office Projects

The Bureau of Labor Statistics has determined, in the course of its two-year investigation into the ratio between direct and indirect labor created by Public Works Administration projects, that on 92 post office projects financed by PWA allotments, 2.6 man-hours of labor were created indirectly for every hour on the job. This is the first report on the ratio of direct and indirect labor for federal projects under the PWA program.

It was recently established as part of the same study that 2.5 man-hours of indirect labor were created for every man-hour of direct labor on non-federal PWA projects.

The present study also disclosed that, of each dollar of PWA funds spent for the construction of the 92 post offices studied, 30 cents went to labor at the site, 54 cents for material (including wages represented in the cost of such materials) and 16 cents for overhead and profit. The percentage of the contract price expended for payrolls at the construction site ranged from 25.7 in the west-south central states to 32.1 in the middle atlantic states.

SOCIETY CALENDAR

AMERICAN CONCRETE INSTITUTE, annual meeting, New York, N. Y., Feb. 23–26.

HIGHWAY CONFERENCE, UNIVERSITY OF ILLINOIS, Urbana, Ill., March 3–5.

AMERICAN RAILWAY ENGINEERING ASSOCIATION, annual meeting, Chicago, Ill., March 16–18.

SOUTHWEST ROAD SHOW AND SCHOOL, Wichita, Kansas, Feb. 23–26.

ASSOCIATION OF HIGHWAY OFFICIALS OF NORTH ATLANTIC STATES, annual convention, New York, N. Y., Feb. 24–26.

MINNESOTA FEDERATION OF ARCHITECTURAL AND ENGINEERING SOCIETIES, annual convention, St. Paul, Minn., Feb. 26–27.

NEW YORK STATE SOCIETY OF PROFESSIONAL ENGINEERS, mid-winter convention, Albany, N. Y., March 6.

FLORIDA ENGINEERING SOCIETY, annual meeting, Tampa, Fla., March 18–20.

AMERICAN WATER WORKS ASSOCIATION, INDIANA SECTION, Indianapolis, Ind., March 25–26.

AMERICAN WATER WORKS ASSOCIATION, FLORIDA SECTION, Ocala, Fla., March 30–April 1.

AMERICAN WATER WORKS ASSOCIATION, KENTUCKY-TENNESSEE SECTION, and SOUTHEASTERN SECTION, joint meeting, Chattanooga, Tenn., April 5–7.

AMERICAN WATER WORKS ASSOCIATION, CANADIAN SECTION, Montreal, Canada, April 14–16.

AMERICAN WATER WORKS ASSOCIATION, MONTANA SECTION, Lewiston, Mont., April 19–23.

AMERICAN WATER WORKS ASSOCIATION, FOUR STATES SECTION and PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION, joint meeting, Philadelphia, Pa., April 22–23.

AMERICAN WATER WORKS ASSOCIATION, ILLINOIS SECTION, Springfield, Ill., April 29–30.

LICENSE EXAMINATIONS

IOWA, examinations for professional engineering on March 18–19 and examination for land surveying on March 20, Des Moines, Iowa.

The ALABAMA ROAD BUILDERS ASSOCIATION at its annual convention in Montgomery, Feb. 2–3, elected Alex Hancock president; vice-president, Fred Owen; Secretary-treasurer, A. G. Underwood.

Officers elected at the annual meeting Jan. 12 of the SACRAMENTO SECTION of the AMERICAN SOCIETY OF CIVIL ENGINEERS were as follows: President, Thomas B. Waddell; 1st vice-president, Herbert H. Hodgeson; 2nd vice-president, Paul S. Jones; secretary, Mark S. Edson.

Work to Start Soon On Lackawanna Housing

PWA Administrator Ickes has announced final approval of the $1,500,000 housing project in Lackawanna, N. Y. This action removes the conditions of the President's tentative approval announced in last October, which was made subject to the acquisition of a suitable site.

Satisfactory options having been obtained on 23 of the 28 parcels of land in the 12-acre site, the Lackawanna City Housing Authority is now authorized to institute condemnation proceedings against the remaining parcels. Preparation of a contract for plans and specifications with an architects' group composed of Harry F. Hudson, chief architect, and Chauncey F. Hudson, Paul Harbach and James W. Kidney, associates, is also authorized.

As laid out in the preliminary plans, the project includes 268 dwelling units in two-story group houses and flats, each dwelling equipped with bath, kitchen and cross-ventilation. Each dwelling will also have an individual furnace, and the group houses will have individual gardens. A manager's office, repair shop, and five stores are also contemplated.

Surveys submitted by the Lackawanna Housing Authority indicated that the present housing shortage in that city has forced workers in the local steel plants to settle as far as 30 miles from their work. Although surveys made a year ago showed only eight vacancies in the whole city, the total residential construction since that time has provided only 16 units.

THE principal engineers on the great construction projects of the Bureau of Reclamation meet with the new Commissioner of Reclamation, John C. Page, in Washington, late in January, after a tour of large engineering projects in the East.

Walker R. Young, Central Valley Project; Frank A. Banks, Grand Coulee Dam; Ralph Lowry, Boulder Dam; R. B. Williams, All-American Canal

H. W. Bashore, Caspar Alcova; R. F. Walter, Chief Engineer; John C. Page, Commissioner; John L. Savage, Chief Designing Engineer.

Obituary

S. D. TEMPLE, 78, civil engineer and formerly city engineer of Anacortes, Wash., died there Jan. 28.

RODERICK W. MCKINNON, chief engineer of the Manitoba department of public works died Jan. 27, aged 52.

E. W. HOBBS, president of the Hobbs-Peabody Construction Co. of Charlotte, N. C., died on Jan. 26.

S. P. KEZIAH, president of the contracting firm of Wilson & Keziah of High Point, N. C., died on Jan. 31.

ALFRED P. LESTER, 76, member of the pile driving contracting firm of Lester & Monohan of Seattle, Wash., died there on Feb. 9.

THOMAS M. HARRINGTON, a building contractor of Winnipeg, Man., who had built many of the first large buildings in Winnipeg, died there Feb. 1 at the age of 93.

DAVID F. MEIKLEJOHN, 60, mining expert and consulting engineer of the Metropolitan Water District of Southern California, died Jan. 19 in Los Angeles.

DONALD W. HOWE, 35, a civil engineer for the Portland Cement Co., committed suicide in Pleasantville, N. Y. on Feb. 14. Mr. Howe was a graduate in 1924 of the Massachusetts Institute of Technology.

FRED P. CHAPMAN, chairman of the Franklin, Mass., sewer commission and in earlier life engineer in charge of the construction of the Indian Territory division of the Gulf, Colorado & Santa Fe Railroad, died at Franklin on Feb. 12 at the age of 71.

GEORGE P. ZOUCK, president and founder of the Consolidated Engineering Co., Baltimore, died there Feb. 5, aged 55 years. Among the buildings erected by the Consolidated Engineering Co. are the Department of Commerce building, the House office building, and the annex to the Library of Congress in Washington.

TIMOTHY R. ATKINSON, consulting engineer and city engineer of Bismarck, N. D., 68, died in Bismarck Jan. 27. Mr. Atkinson was assistant state engineer of North Dakota from 1905 to 1907 and state engineer from 1907 to 1913. Since that time he was almost continuously city engineer of Bismarck and county engineer of Burleigh county and also practiced consulting engineering throughout the western part of the state.

ANGUS F. BARCLAY, who resigned as general manager of the New Orleans

Public Belt Railroad on Jan. 1, 1937, died in New Orleans Jan. 31 at the age of 58. Mr. Barclay was connected with the New Orleans Public Belt Railroad from 1906 until 1912 as field engineer and assistant engineer. After four years with the Texas & Pacific Railway he returned to the Public Belt as chief engineer; he was promoted to the position of general manager in 1934, which position he held until his recent resignation.

JOHN CHAMBERS, 72, for the past 16 years chief engineer and superintendent of the Louisville Water Co., died Jan. 20 in Louisville. Mr. Chambers, a graduate in civil engineering from Rensselaer Polytechnic Institute, was connected in his early years with the Louisville & Nashville, the old Louisville Southern and the K&I Terminal Railroads. After several years consulting practice he became city engineer of Louisville in 1908 and except for a few years' work for the Kentucky government, he held that position until 1921 when he resigned to go with the water company.

JOHN J. BACKUS, general manager of the department of building and safety in Los Angeles, Calif., died Jan. 24 in Los Angeles, aged 73. Starting as a building inspector 31 years ago, Mr. Backus soon became head of the division of the city government which supervised building construction. Before the formation of the present building and safety department, which started in 1925, when he was elected to the position of general manager, he had been chief building inspector. Mr. Backus was a past president of the Pacific Coast Building Officials Association and a life member of the Southern California chapter of the American Institute of Architects.

CHARLES T. RHODES, 60, land engineer for the Buffalo, Niagara & Eastern Power Corp., died Feb. 11 in New York City. Mr. Rhodes became connected with the engineering department of the Niagara Falls Power Co. in 1893, later entering the employ of the Ontario Power Co. He was with the Niagara, Lockport & Ontario Power Co. as a field engineer and later with the Niagara Power Co. as a construction engineer.

WILLIAM S. TWINING, who retired in 1924 from his position as director of the Philadelphia department of city transit, died at Fort Myers, Fla. Feb. 8 at the age of 71. After graduation in 1887 from Allegheny College and three years service there as instructor, he became assistant engineer for the Thompson Houston Co. of Boston. He was later engaged on the electrification of the Harlem Bridge, Morrisania & Fordham Railway, and in 1893 became chief engineer of the Philadelphia Rapid Transit Co. After seven years service with the transit company he became engineering manager for the New York City consulting firm of Ford, Bacon & Davis, holding that position for six years until, in 1916, he took the directorship of the Philadelphia department of city transit.

LARGER AWARDS FOR THE WEEK

Power station, Duquesne Light Company, Pittsburgh, Pa.	$4,000,000
Chemical plant, California Chemical Company, Newark, Calif.	1,000,000
Power plant, Libbey-Owens-Ford Glass Company, Rossford, O.	600,000
Professional and apartment building, Mrs. Hannah Heimovitch, Hartford, Conn.	500,000
United States post office and courthouse, Los Angeles, Calif.	5,907,000
Highways, Texas	694,000
Highways, Texas	994,000
Highways, New York	1,048,000
Highways, Illinois	603,000
Completing Riverdale Avenue separation, Contract HHP-36-1, Henry Hudson Parkway, Bronx County, N. Y.	544,000
Bridge over Missouri River from Atchison, Kansas to Buchanan County, Missouri	554,000
Dredging and bulkheading Constable Point—New York Bay waterfront, Bayonne, N. J.	3,280,000
Steel rails, 15,000 tons, Chicago, Burlington and Quincy Railroad, Chicago, Ill.	675,000
Placing electric facilities underground, day labor. Part of 1937 Program, Public Service Corporation of New Jersey	2,000,000

INDEX NUMBER

ENR Cost	1913 =100	1926 =100	ENR Volume	1913 =100	1926 =100
Feb., 1937	226.45	108.85	Jan., 1937	165	72
Jan., 1937	223.45	107.41	Dec., 1936	206	90
Feb., 1936	201.20	96.71	Jan., 1936	248	109
1936 (Av.)	206.46	99.24	1936 (Av.)	185	81
1935 (Av.)	195.22	93.84	1935 (Av.)	135	58
1934 (Av.)	198.10	95.23	1934 (Av.)	114	50

CONTRACTS
(Thousands of Dollars)

	Weekly Average Feb. 1936	Prev. 4 Weeks	Week Feb. 18 1937
Fed. Government	$2,468	$2,929	$6,842
State and Municipal	28,087	23,778	17,856
Total public...	$30,555	$26,707	$24,698
Total private..	10,570	14,094	17,860
Week's total...	**$41,124**	**$40,801**	**$42,558**

Cumulative to date:
1936 (8 weeks).....$418,086,000
1937 (7 weeks).....$290,096,000

Note: ***Engineering News-Record*** **reports waterworks and earthwork, reclamation or waterways projects of $15,000 and over in size; other public works, $25,000, industrial buildings, $40,000; other buildings, $150,000 and over. The figures above represent the volume of contracts and large force account projects throughout the U. S. that are of these minimum sizes or over.**

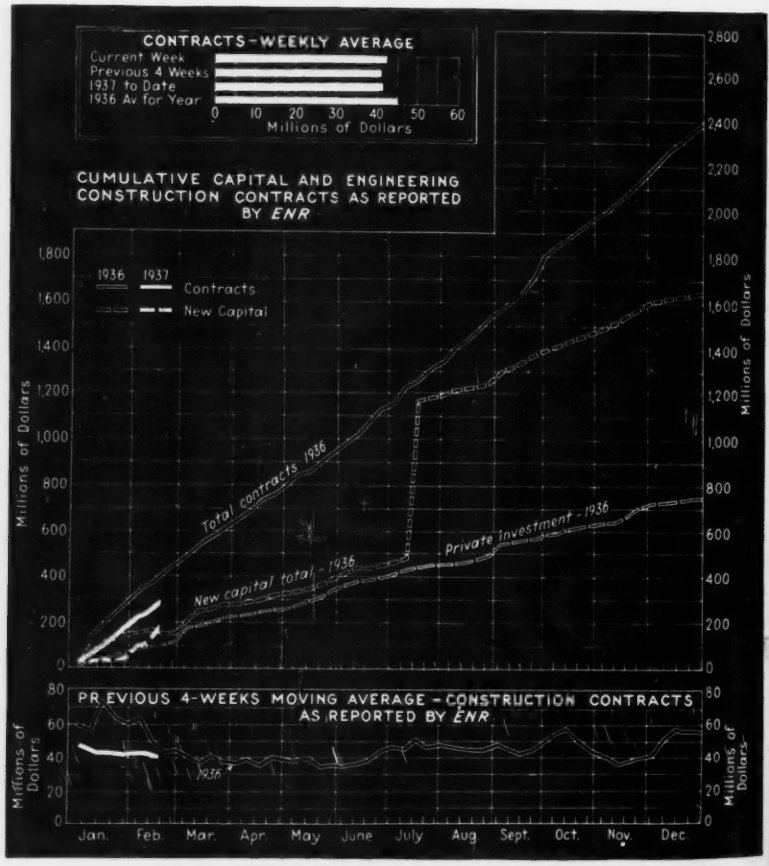
NEW PRODUCTIVE CAPITAL
(Thousands of Dollars)

1937	Week Feb. 18	Cumulative
Private investment	**$52,870**	**$170,986**
State and municipal bonds	52,870	115,983
Corporate securities	.....	55,003
Federal financing	**$ 370**	**$—3,691†**
PWA non-federal Projects	370	1,245
Total non-federal	**$53,240**	**$172,231**
Federal projects	.....	.....
Total	**$53,240**	**$172,231**

Cumulative to date:
1936 (8 weeks).....$169,059,000
1937 (7 weeks).....$172,231,000

Note: These figures include private bonds and stocks sold for new construction purposes; state and municipal bonds for construction; PWA loans and grants to states and municipalities, RFC direct purchase of bonds for "self liquidating" projects, and 25 per cent of WPA construction appropriations.

† **Includes transfer from federal to private investment financing through sale by RFC of PWA bonds.**



1926
100
72
90
109
81
58
50

Millions of Dollars

Millions of Dollars